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WEED CONTROL

# WORLD CROPS

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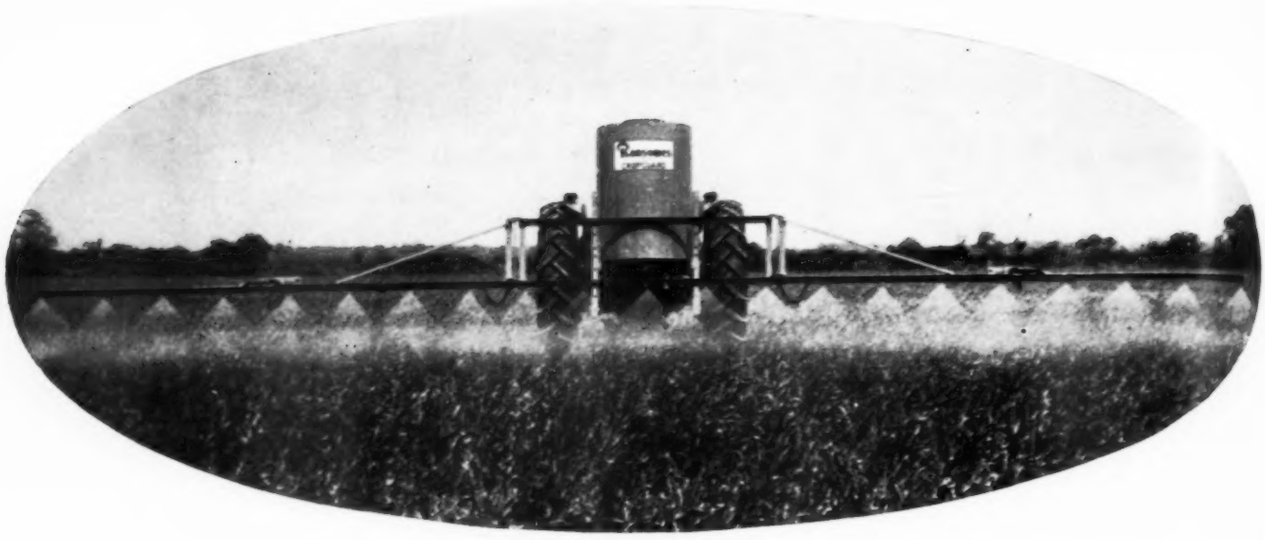
**AGRONOMY, HANDLING, PROCESSING, STORAGE AND PROTECTION**
**SOILS, CHEMICALS, IRRIGATION, ENGINEERING AND ECONOMICS**

**VOLUME 8, No. 6** **JUNE 1956**

A Publication of The Leonard Hill Technical Group

*Undersown clover unharmed, thistle dying, 3 weeks after spraying with 'Tropotox'.* (See contents page.)



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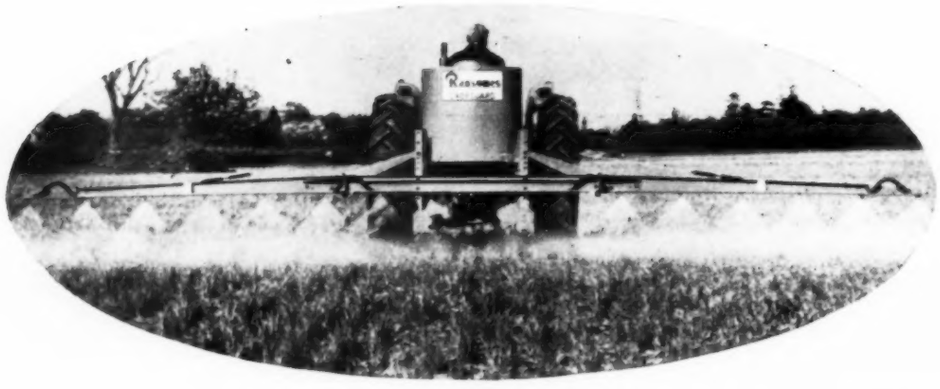

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WORLD CROPS

Vol. 8, No. 6 — JUNE 1956

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**WEED CONTROL** (*front cover illustration*)

*This shows the effect of the new selective weedkiller 'Tropotox'* when sprayed in wheat undersown with clover. 'Tropotox' can be safely sprayed in cereals as early as at the 2-leaf stage and in clover at the first trifoliate-leaf stage. It can also be used for weed control in certain varieties of peas. The use of 'Tropotox' in other crops is under trial. Further information on this weedkiller with the entirely new mode of action may be obtained from the manufacturers:*

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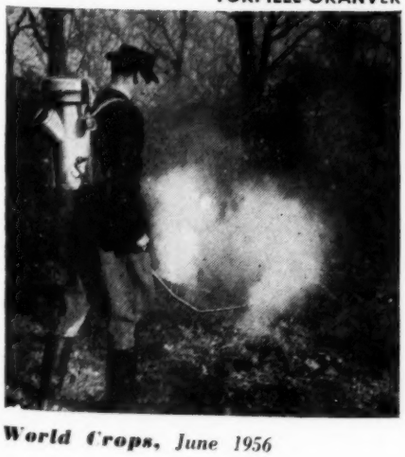

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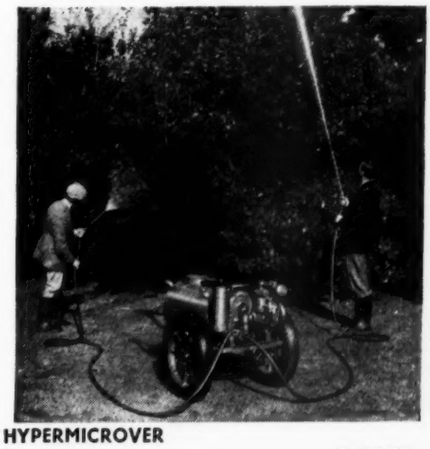

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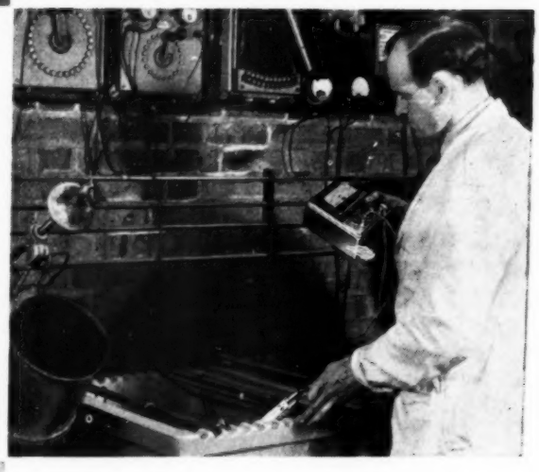

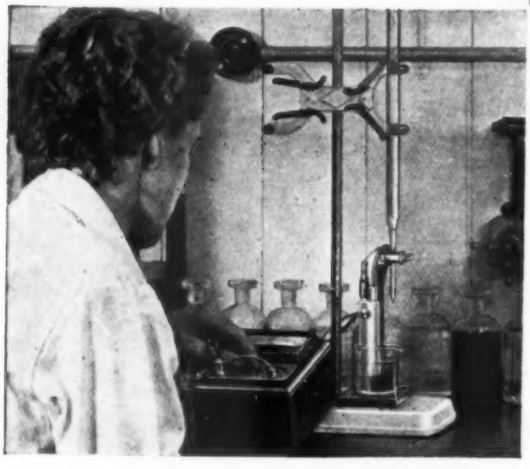

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# Editorial Comment

## Crop protection

ALTHOUGH great advances have taken place in the study and practice of crop protection in recent years many complex problems remain unsolved. Only by unceasing trial and experiment can we hope to improve crop yields even further and to cut down the amount of labour required for cultivation. In this issue several experts have contributed a series of articles showing the trends that are being followed in the production and application of improved weedkillers.

## Agricultural hazards

IN this issue there is a note entitled ' Field Methods for Measurement of Pesticide Absorption '. This subject is topical at the present time with the approach of the new growing season, which will again bring about potential danger to those who have to handle insecticides and fungicides in the field, orchard or glasshouse. We have made reference to this subject before, but it is so important that we feel that we ought to draw the attention of our readers to it again. There have been few important changes in the chemicals in common use during the last 12 months. Among the insecticides there is a general trend towards the use of organophosphorus compounds, such as malathion, diazinon and ' metasystox ', that are less toxic than those previously used. Nevertheless, TEPP and parathion have not by any means been displaced. On the other hand, among the chlorinated hydrocarbon group of insecticides the new chemicals, such as endrin, aldrin and dieldrin, are more toxic to mammals than the older materials like DDT and BHC (benzene hexachloride).

The *British Medical Journal* says that there were reports of only two fatalities due to agricultural chemicals from the British Isles last year; these were alleged to have been caused by mercury in one case and arsenic in the other—thus serving as a reminder that older and perhaps more familiar poisons may still be dangerous. Indeed, the increasing popularity of mercurial preparations as fungicides in leaf sprays suggests a need for vigilance in order that this well-known industrial hazard does not also become a danger to health in another field of use.

Some critics suggest that the population is in danger of poisoning by the indiscriminate use of pesticides in agriculture and food storage; they usually imply that no one knows what is going on. Such criticism has been effectively answered in a lecture to the Pesticides Group and Agriculture Group, Society of Chemical Industry, recently by Dr. E. J. Miller. He has described the work of the inter-departmental organisation which, with the active collaboration of the pesticides industry, is reviewing the existing and proposed uses of these substances. There is no foundation for the legend that insecticides, fungicides, herbicides and so on are wildly and indiscriminately applied with no official knowledge of what is being done. Dr. Miller described how the sub-committee (the Scientific Sub-Committee on Poisonous Substances Used in Agriculture and Food Storage), of which he is secretary, collects the evidence before it ' clears ' a pesticide for some particular use.

Systemic insecticides—those taken up by the plant—have many uses, but fear has been expressed that they might be turned by the plant into some new and specially dangerous substance. Recently published work has shown conclusively that in one case no effective change takes place in the plant, while in the other the metabolism of the insecticide within the plant follows exactly the same path as it does in the mammal. In an active and expanding field of applied science, such as the use of chemicals in agriculture, potential dangers to health may arise at any time, but there is no ground for public anxiety on the score that no official watch is being kept on the situation. In Britain the pesticide industry has a well-established tradition of co-operation with the official agricultural side; and on the scientific sub-committee already mentioned there sit no fewer than four members of the medical profession to advise on toxic hazards. Accidents are bound to occur from time to time, but continued training and education in the handling and disposing of these toxic materials will prevent many of them. Prompt and effective medical treatment is life-saving in the majority of accidents that do occur.

## Puzzle corner

A PROBLEM which lacks interpretation can be found in the last two annual reports from the Edinburgh and East of Scotland College of Agriculture. This college, like other agricultural colleges in Scotland, is a regional centre for soil sampling and advisory services. In the last but one report a steady but definite fall in available phosphate levels of sampled soils was revealed. In the years 1946–53 the percentage of all samples tested having a *low* classification for this nutrient was 31; in 1953–54 this percentage was 46; similarly, the percentages for *high* classifications were 38 (1946–53) and 29 (1953–54). The comment was made in that report that a similar trend had been noticeable for three years. It was a fair deduction, therefore, that insufficient attention was being paid to the maintenance of phosphate adequacy. The fact that there had been some increase in the number of marginal soils

sampled was regarded as only a partial explanation. However, in the latest report—for 1954–55—this trend has not only vanished, it has been abruptly reversed. The percentage of low-phosphate-status soils has fallen to 31 and that of high-status soils has risen to 47. It is difficult to be content with the explanation that in each year these proportions are determined by chance, by the random intake of samples from many farms; for in each year up to 10,000 soil samples may be tested and this is a large enough figure to overcome much of the influence of chance. The ' total sample ' may not be statistically designed, but it has a fair degree of broadness. Why in the period of a single year has one region's soil sampling shown a 46% proportion of low phosphate results falling to 31%, and 29% proportion of high results rising to 47%? No comment upon this sudden change is made in the College's report.

It is pointed out, however, that 800 more samples were taken in the summer six months in 1954–55 than in 1953–54. That is to say, there was shift in sampling time—towards summer and away from winter—of about 10%. Has this produced a more favourable picture for phosphate contents of soils? Does warmer soil encourage biological processes of converting unavailable phosphate into available phosphate? Or does more summer sampling simply mean that more soils still deriving benefits from spring phosphate dressings are sampled?

The problem is not of purely regional interest, nor should it be dismissed as a numerical curiosity. It raises a major question for farmers and advisors. How much is the value of soil testing dependent upon the time at which the sample is taken? Or upon the weather pattern of the preceding months?

## Trace elements and disease

DEFICIENCIES of trace nutrients in crops are usually considered from the viewpoint of their direct effects upon plant metabolism and growth. This may well be too narrow. We have long accepted the view that the major or macro-nutrient potassium gives many plants greater resistance to disease. There is no reason to suppose that trace elements cannot function similarly. Research work at the Rubber Research Institute of Malaya, reported recently in *Nature* (1956, **177,** 619), has shown that infection of the Hevea rubber tree by the fungus *Oidium heveae* is greatly encouraged by zinc deficiency. In glasshouse experiments it was not similarly encouraged by deficiencies of other trace nutrients, *e.g.* copper and molybdenum. Furthermore, young plants fed discontinuously with a zinc-deficient nutrient-solution developed heavy infection of the fungus only on those parts which had been formed during the period of zinc-deficient feeding. *Oidium heveae* does not cause serious economic losses in Malayan rubber plantations, but the reverse is true in Ceylon. Does this mean that Ceylon soils are more zinc-deficient? This is probably true, for soils in dry climates are much more prone to copper and zinc deficiencies than soils in humid climates. In arid areas of Australia supplying zinc to soils has made the difference between infertility and productivity. Academically at least, and perhaps economically as well, the possibility of controlling losses due to a fungus disease by applying a trace-element fertiliser is intriguing.

## Labourer's hire

SOME disturbing information about the agricultural ' feather-bed ' has been given in a recent FAO document, 'Agriculture in the World Economy '. However glibly urban citizens may talk or think about farmers' wealth, the truth is that in hardly any part of the world do ' farmers receive a share of the national income proportionate to their numbers '. In many countries the discrepancy of reward is large, though, as a general rule, the discrepancy is smallest in the most industrialised countries. How far this latter point is a simple product of the old economic law of supply and demand makes an intriguing speculation—the more who farm, the less their pay etc.

Figures gathered by FAO reveal the situation plainly enough. In the following Table 100 represents the average income per head from all occupations other than farming, forestry and fishing. In the selected countries, therefore, farm incomes are above or below the national standard according to whether the index figure is above or below 100.

| *Country* | 1938 | 1948 | 1949 | 1951 | 1952 |
|---|---|---|---|---|---|
| New Zealand .. | — | 150 | 156 | 132 | — |
| West Germany .. | 44 | 67 | 72 | 85 | 93 |
| Denmark .. .. | 67 | 77 | 82 | 78 | 87 |
| Canada .. .. | 33 | 62 | 57 | 68 | 60 |
| Ireland .. .. | 31 | 48 | 47 | 44 | 48 |
| Japan .. .. | — | 31 | 29 | 34 | 32 |
| Britain .. .. | — | 101 | 103 | 89 | 93 |

Except for Japan, for whom a prewar index is not given (the same applies to Britain, but an index under 100 can be safely assumed), the postwar position of farmers is one of improvement. In some cases there has been a falling-back since 1948—no doubt reflecting less general anxiety about food supplies!—but this, at any rate up to 1952, has not eroded the gains since 1938. The gradual slide from above 100 to below it in the case of the annual British index is particularly interesting. That the productive, hard-working Danish farmer does not score a better index than 87 will surprise many agriculturists. But nowhere, except perhaps in New Zealand, can the rewards of farming be likened to the supposed luxury of a feather-bed! Nor would anybody expect the New Zealand farmer not to obtain a generous share of national income, for

New Zealand is unique for her high food-export figure per head of population. People who refer critically to wealthy farmers have geared their views to old and out-of-date standards. They expect farmers to be as under-rewarded as they were before the war and signs of improved economic position are resented. If a manufacturer of plastic novelties acquires an enviably expensive car, he is regarded as a shrewd man, a successful 'enterpriser'—but should a farmer buy a new car, albeit one of moderate cost, he is making too much money! The plain truth of these FAO income indexes needs some most emphatic publicity. The reward for farming's labour and anxieties is *not* high.

## Potato harvesting

FOLLOWING a series of field experiments the National Institute of Agricultural Engineering have emphasised the great importance of maintaining a high rate of feed to pickers working with a potato harvester. If manual separation is relied on to produce a clean sample, a fast rate over the ground is essential to obtain the maximum output per man. This calls for a large team of pickers with one at the end of the conveyor belt to ensure that nothing is missed. When the labour force is small, lifting and cleaning is best done in two operations.

It is estimated that ½ hour per acre is the minimum rate for the efficient use of labour. Thus, allowing for a 15% loss of time at headlands, this means a forward speed of 2 m.p.h. in the row (or 1 m.p.h. for two rows), and a feed of 400 lb. of potatoes per minute to the first picker.

These experiments have also shown that potatoes are best swept off the conveyor rather than grasped. When there is a lot of trash a fast belt speed, which gives an 'open' mixture, is preferable; there is little to be gained by different arrangements of the pickers at the belt.

## Dis-orientated weeds

IT was reported recently that more news about a series of new types of chemical compounds which kill weeds before they appear above ground by distorting their response to light and gravity may be expected later this year or in 1957.

Earlier postwar experiments with a number of compounds, which were found to have this effect on the germinating weeds, failed to yield commercially usable weedkillers. This was due to the fact that the compounds could not be made sufficiently selective and affected the growth of the crop as well as that of the weeds. It seems likely, however, that new compounds now being developed, which also make the shoots and roots of weeds grow out in a dis-orientated, or random, fashion, may prove to be sufficiently selective for use with at least some agricultural crops.

## Veritas prævalebit

THE removal, through his resignation, of Professor Lysenko, the Soviet biologist, from his post as President of the All-Union Academy of Agricultural Sciences was not surprising, for he has been severely criticised since Stalin died. As Stalin's 'dictator of genetics', he held a monopoly in genetics and agricultural sciences that has since been attacked as hampering Soviet scientific progress.

Born in the Ukraine in 1898, Professor Lysenko first attained scientific prominence when he discovered a method by which winter varieties of tomatoes could be sown in spring and ripened in one season. He developed theories first propounded by the Russian scientist, Michurin, that environment played a greater part in plant growth than heredity.

These theories were, of course, in direct contrast to those of Western scientists and therefore suited the Stalin cult. From the secrecy of his laboratories he issued fantastic claims that he could convert rye into wheat and that he could grow wheat in the arctic wastes of Siberia.

An indication of Lysenko's power was the way in which those who did not conform to his views were dismissed. Professor Vavlov, the former President of the Soviet Academy of Agricultural Sciences, was sent to a Siberian labour camp, where he died. In 1948 Lysenko announced that his biologist opponents were 'taking an incorrect biological and ideological standpoint' in genetics and agricultural sciences.

As a result of this statement several prominent scientists were dismissed and a number of institutes were closed.

In 1954, the year after Stalin died, a major failure in Russian wheat production prompted Khrushchev, the First Secretary of the Soviet Communist Party, to condemn the system of crop rotation based on Lysenko's theories. He announced that as a result of mistakes in Lysenko's grain-growing policy an area of 2,471,000 acres had gone out of production. This was the signal for the Press to start attacking him. In 1955 an article in the *Literary Gazette* said that Lysenko's attempts to impose a monopoly in scientific ideas had led to the results of experiments being distorted to fit orthodox theories.

During Lysenko's reign Dr. S. Cross Harland, the British geneticist, once had the opportunity of meeting him. He is reported to have said afterwards: 'I interviewed Lysenko for nearly three hours. I found him completely ignorant of the principles of genetics and plant physiology. To talk to Lysenko was like trying to explain differential calculus to a man who did not know his 12 times table'.

It is to be hoped that the removal of Lysenko from office will now facilitate a greater freedom of discussion between Russian and Western biologists.

## Fodder trees for sheep

FODDER trees play an important part in the economy of Queensland's Merino sheep industry by providing a valuable reserve of fodder during drought, and in times of plenty leaves from the low branches and windfalls add variety to the Mitchell grass pasture. Dr. J. M. Harvey, biochemist in the division of animal industry in the Queensland Department of Agriculture, points out that the number of species is large and includes kurrajong, gidyea, boree, myall, supplejack, mulga, wilga, plum, leopardwood, rosewood and ironwood.

In favour of fodder trees is their superior feeding value compared with grass that has passed its growing stages. The ability of these evergreens to root deeply and draw on reserves of moisture and nutrients not available to most grasses makes their nutritional status less variable than that of grasses. Many of the trees are legumes, and this indicates good protein value for wool production. As they are green, their vitamin A level is greatly superior to that of dry feed. Another strong point in favour of trees is their relative safety from fire and insect plagues and their provision of shade.

At times the leaves of some fodder trees are poisonous. Rosewood, for example, may build up prussic acid and kill sheep. Therefore, don't feed one type of scrub only, or if you must, lop the risky tree a day or so before feeding. Prussic acid is largely lost when the leaf wilts.

## Potash problems

AN interesting query on the subject of potash manuring has been raised by Dr. E. W. Russell in his annual review of soil and fertiliser research in a recent issue of the *Royal Agricultural Society Journal*. Both Dutch and Danish research are quoted to show that with soils of low-potash-status deficiency correction is not quickly achieved by giving heavy dressings of potash fertiliser. What might be called the complete reverse of 'placement' appears to be in operation—crops do not draw upon the added potash sufficiently until it has become evenly distributed over the soil particles, a process that is fairly slow. Dutch studies with potatoes growing in soil of very low potash status still had leaves with an unusually low potash content and cropped very moderately even though a 4-cwt.-per-acre dressing of 60% muriate of potash had been given. On much the same line, Danish work has led to the recommendation that on soils moderately low in potash it is better to give a very heavy and occasional dressing—8 cwt. of muriate of potash every five years—than smaller, annual dressings such as 1½ cwt.

It is pointed out in Dr. Russell's commentary, however, that this idea of massive and occasional dressing with potash is only applicable for soils of low potash status. The same policy, if operated on soils fairly well endowed with potash, could bring reduced yields.

It would seem desirable for this theory—essentially, that potash needs to become thoroughly incorporated with the soil before it can be efficiently utilised by current crops—to be more widely investigated. A good deal of our contemporary fertiliser practice is hardly compatible. Well above four-fifths of the potash applied to farm crops in Britain is given in the form of compounds and over 90% of the compounds used are granular. Potash in a granule, especially if the dressing has also been drill-placed rather than broadcasted, must take all the longer to become well incorporated with the soil. Yet it seems doubtful whether such dressings have failed to give their fully expectable benefits in most cases, even in thin-soiled potash-hungry areas such as the Wiltshire uplands. Some research with radioisotopic potassium is indicated.

## Festival of trees

A REMINDER to the Italian people of the importance of forests in the economic life of the country and to imbue a love of nature and a respect for plant life, especially among the young, is given every year by the traditional Festival of the Trees. The Festival was instituted by Guido Bacceli, then Minister of Education, in 1899, subsequently lapsed, and was revived in 1948. About 7,000 communes now observe it; nearly two million school children take part and some 1,300,000 trees are planted.

In addition to its educational value, the Festival, says the journal *Agriculture*, has the very practical effect of enriching Italian timber resources by regular planting. The area under forests in Italy is less than 20% of the total—a much lower percentage than in many other countries. At the same time, Italy is very densely populated, and the country uses much more timber than it can produce. Large imports from abroad are a heavy burden on the foreign trade balance. The present forest area can produce about 10 million cu. m. of timber. The amount cut each year is much greater; in 1946–47 it was almost 15 million cu. m. Measures must therefore be taken to protect timber resources—by more reafforestation and by planting fast-growing species.

The educational campaign which accompanies the Festival also helps to show how forests give protection against avalanches, landslides and floods; their importance for soil conservation purposes; how they produce various products essential to everyday life; their role as summer and winter resorts; and the way in which they can help to make an area more healthy.

*Who sows a field or trains a flower,*
*Or plants a tree, is more than all.*

WHITTIER

# WEED PROBLEMS IN WORLD AGRICULTURE

H. P. ALLEN, B.SC., PH.D.

(*Senior Botanist, Plant Protection Ltd., Fernhurst Station*)

*Many advances have been made in the use of chemical weedkillers in the last 15 years, the expansion dating from the discovery of the hormone-type selective weedkillers MCPA and 2,4-D during the second world war. Dr. Allen has reviewed the situation and brings it up to date by mentioning some of the newer chemicals and their application in freeing the world's agricultural lands from their common enemy, weeds.*

OF the many common problems shared by farmers throughout the world, one of the most pernicious and troublesome is the loss of crop due to competition from weeds. The extent to which the weed problems are being tackled is very closely related to the organisation of agriculture in the countries in question.

The Chinese padi farmer and the Indian smallholder tackle their weeds by hand, by family labour in fact. American and British farmers, on the other hand, use the most up-to-date discoveries in chemicals and machines as their weapons to fight the weeds.

During the last 15 years the use of chemical weedkillers has expanded to a tremendous extent. This expansion really dates from the appearance of the hormone-type selective weedkillers, MCPA (4-chlorophenoxyacetic acid) and 2,4-D (2:4-dichlorophenoxyacetic acid) in the early 1940s. MCPA was discovered in Great Britain in 1941 by Slade, Templeman and Sexton and these workers discovered 2,4-D in 1942. 2,4-D was discovered by independent work at Rothamsted and in the U.S.A., also in 1942. Perhaps it would be nearer the mark to say that the weed-killing revolution has taken place over the last 10 years, because during the war years these discoveries could not be put to practical use.

## Selective weedkillers

Chemical weedkillers fall into certain broad and well-defined classes. Those with a selective action naturally have the greatest appeal because they can be used to suppress weeds growing in crops. The greatest progress in the use of selective weedkillers has been made in cereal crops—wheat, barley, oats and maize in particular.

The selective weedkillers used in cereals fall into two fairly well-defined groups. The most widely used are the growth-regulator weedkillers, MCPA and 2,4-D, whose action is physiological. There are now new members of this group, the phenoxybutyric compounds, MCPB (2-methyl:4-chlorophenoxybutyric acid) and 2,4-DB (2:4-dichlorophenoxybutyric acid).

## Dinitro compounds

The second group of selective weedkillers act mainly by contact and utilise morphological differences between cereals and broad-leaved weeds as the basis for their selective action. It includes the dinitro compounds; DNC and dinoseb are examples. Sulphuric acid, too, is a member of this group, but, whereas the dinitro compounds are only partially contact in action, sulphuric acid is solely a contact weedkiller. Its selectivity is due to the fact that little of the chemical is retained upon the smooth leaves of the cereal crop and hardly any reaches the protected growing point. The broad-leaved weeds with their more retentive leaf surfaces and their exposed growing points naturally suffer very much more damage than the cereal crop which they infest.

*Spraying rice in Italy with MCPA, using a man-carried boom sprayer*

### General weedkillers

This type of weedkiller has no selective action and will kill almost any plant. Such weedkillers include sodium chlorate and sodium arsenite; they are used for killing weeds on paths, roadsides, railways etc.

Also in the same class come the newer methyl urea derivatives, CMU and PDU. Although essentially non-selective, they may be used at low rates as pre-emergence weedkillers in certain crops.

The uses to which these various chemicals are put can perhaps best be described by considering the main crops of the world separately. Cereals are by far the most important.

### Weedkillers in cereals

In temperate cereals the uses of MCPA and 2,4-D are now well known. Although rates of application differ from one part of the world to another, the basic techniques necessary for successful weed control are very similar.

Much depends on the time of spraying. From the point of view of weed control with the growth-regulator weedkillers in particular, the earlier the application the better as a rule, but timing is also bound up very closely with safety of the cereal crop.

Spring oats, for instance, can be sprayed with MCPA at any stage from emergence of the first true leaf right up to just before the beginning of heading (*e.g.* ear emergence) with no adverse effect on yield and only a very small increase in the number of abnormal panicles. This does not apply, however, to wheat and barley. If these crops are sprayed early with MCPA or 2,4-D, there may be a considerable increase in the number of abnormal ears which could lead to yield reductions, in barley especially.

The vast acreage of temperate cereals sprayed in the U.S.A., Canada and Great Britain particularly is tribute enough to the startling success of the growth-regulator weedkillers, but their limitations cannot be denied. Several weeds are beyond the range of MCPA and 2,4-D and here the dinitro compounds, particularly DNC (dinitro-*o*-cresol), come into the picture. These compounds may be applied to wheat, barley and oats at a somewhat earlier stage than the growth-regulator weedkillers; indeed, their success against many annual weeds depends on application while the weeds are young. Their limitation is that they have poison hazards, and DNC, at any rate, *must* be applied in high volumes of water (80–100 gal. per acre).

### Some techniques for maize

Great strides have been made in the use of weedkillers in maize, particularly with MCPA and 2,4-D derivatives. There are two techniques of application. First is the ' pre-emergence ' method, where the weedkiller is applied after the maize has been planted but before it emerges through the ground. Here the residual nature of MCPA and 2,4-D in the soil is an advantage, because the chemicals may be applied to the soil quite a few days before the weeds themselves germinate. The second method is 'post-emergence', i.e. application after the maize is through the ground, and here special care is necessary to minimise the risk of injury to the maize.

In South Africa the pre-emergence technique is practised in the rather wetter eastern area of the Transvaal, where the soil can be relied upon to be moist enough for application of MCPA or 2,4-D to be successful.

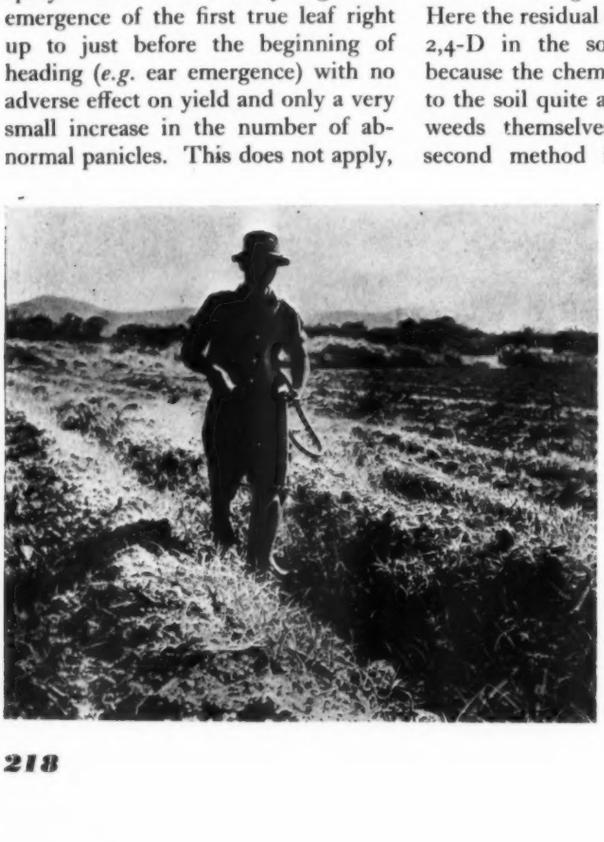
In the drier western Transvaal post-emergence application is the more favoured technique for three reasons. First, the soil conditions at the time of application may be too dry for pre-emergence methods to be very successful. Second, the *Cyperus* weeds, *i.e. C. rotundus* and *C. esculentis*, are not present in any quantity as they are in the eastern Transvaal. Third, some of the weed species can be dealt with better by post-emergence applications.

Opinions differ as to the safest time to apply MCPA or 2,4-D post-emergence to maize, but experience in East Africa has been that risks are at a minimum if application is made when the crop is between 2 and 6 in. high and the rate of application does not exceed about 1 lb. of active acid equivalent of the chemical per acre.

Other pre-emergence types that have been used against weeds in maize are the methyl urea derivatives, CMU [3-(*p*-chlorophenyl)-1:1-dimethyl urea] and PDU (phenyl dimethyl urea), particularly for suppressing grasses and sedges. 2,3,6-Trichlorobenzoic acid has created interest in the U.S.A., particularly for use against broad-leaved species.

The use of chemical weedkillers in maize does not replace the need for cultivations, but it can reduce very considerably the number of cultivations necessary to bring about high yields. Evidence from South Africa demonstrates very clearly the considerable benefits that can be obtained in maize by the careful application of the growth-regulator weedkillers.

Most of the practical applications of chemical weedkillers in maize are made on ordinary maize varieties. Much less is known about their safety on the many varieties of hybrid maize. Experiments in America and in France have demonstrated that there are decided varietal differences in susceptibility, particularly to MCPA and 2,4-D. Clearly, a great deal more work is necessary in this field.



*Hand spraying against weeds in sugar-cane before planting. Pentachlorophenol is being used as a contact weedkiller on the emerged grass weeds. 2,4-D is added to kill broad-leaved weeds*

### Weeds in sugar-cane

Sugar-cane is a crop which lends itself well to the use of chemical weedkillers. A number of chemicals are being used in practice, and techniques of application depend mainly on the dominant weeds and on the stage of development of the sugar-cane. Perennial grass weeds can be dealt with by heavy applications of TCA, dalapon or even sodium chlorate when the land is out of cultivation, but the persistence of the weedkiller used must be remembered. In newly planted cane the first application of an MCPA or 2,4-D spray is often made after the setts have been planted but before the shoots emerge through the ground. A second application of MCPA or 2,4-D will possibly be made a few weeks after emergence, probably following the earthing-up of the crop, with further applications at intervals as necessary. This is a quite common practice in Mauritius, where the aim throughout is to attack the weeds just as they are coming through the ground.

In established or ratoon cane MCPA or 2,4-D is often combined with pentachlorophenol and sometimes sodium chlorate or TCA is added in very small quantities (say up to 5 lb. per acre). The idea behind this ' cocktail ' mixture is to achieve as wide a weed control as possible. The hormone weedkillers will suppress a number of the broad-leaved weeds. Pentachlorophenol will look after young grasses and will scorch foliage of some broad-leaved weeds that would normally be resistant to the growth regulators; and sodium chlorate or TCA will check the growth of perennial grass weeds.

CMU is used in sugar-cane in certain countries, particularly in Hawaii, where it has proved effective against nut-grass (*Cyperus rotundus*). The rate of application for this purpose is in the region of 4 lb. per acre.

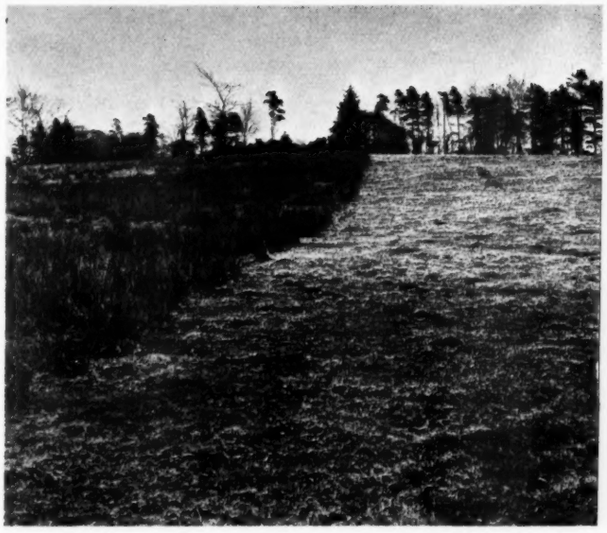
The method of application of weedkillers in sugar-cane depends to a large extent on the terrain. In Mauritius all of the work is done by man-carried knapsack sprayers. In the West Indies a certain amount of ground-machine spraying is carried out. In Hawaii CMU has been applied in some instances from the air.

### Weeds in rice

MCPA and 2,4-D are used to suppress broad-leaved weeds like *Alisma plantago*, *Scirpus maritimus* and *S. mucronatus* growing in ricefields and are very effective against these species. There have been instances of damage to rice by 2,4-D, however. Two factors complicate weed control in the rice crop.

The first is the presence of grass weeds, especially *Panicum cras galli*. 2,4-D/TCA (trichloroacetic acid) and MCPA/TCA mixtures have been tested, and the former is in commercial use in Italy for pre-sowing applications, but no really consistently effective and safe technique involving chemicals is available at the present time.

The second complication is the application question. If the field can be drained before spraying, then ordinary tractor-mounted, low-volume sprayers can be used fairly effectively; other methods include man-carried boom sprayers operated either by knapsack or from the headlands, ordinary knapsack spraying and, where the area of rice is sufficiently large, aerial spraying. In vast areas in India and the Far East, however, most of the rice weeding is still carried out by hand.



*Control of rushes in Northern Ireland with MCPA. The right-hand side of the field was sprayed in early June 1955. The rushes were cut three weeks after treatment and nitrogen and phosphate fertilisers applied in September. (Photo taken 22 February, 1956)*

### Grassland problems

So far we have considered crops where the issue is straightforward. The aim behind the use of chemical sprays has been simple, namely, to remove weeds from a reasonably resistant crop. In grassland the use of weedkillers is complicated by the fact that very often the legume constituent of the grass sward is rather susceptible to damage by those weedkillers that are most suitable for the control of grassland weeds, *i.e.* MCPA and 2,4-D. This has been responsible in large measure for the relatively slow development of the use of MCPA and 2,4-D in temperate grasslands.

In tropical and sub-temperate pastures the problem is different and is not complicated by the presence of clovers. The main weeds are woody in nature and considerable use is being made of 2,4,5-T, a growth-regulator weedkiller particularly suited for the control of woody species.

### Treatment for legumes

In general, it is held that in young swards containing a high proportion of white clovers (*Trifolium repens*) (*e.g.* wild white clover, New Zealand mother white clover, Dutch white, S.100) there is little scope for MCPA or 2,4-D. Where red clovers (*T. pratense*) (*e.g.* English broad red, late-flowering red etc.) form the only legume component of the sward, MCPA may be used at up to $\frac{3}{4}$ lb. of acid equivalent per acre under U.K. conditions with only a slight setback to the clover. This treatment has been successful even with red clover just past the two trifoliate leaf stage, although some retardation of growth must be expected.

On *established* swards, where only wild white clover is likely to be present, MCPA and 2,4-D may still depress growth, but here speed of recovery depends to a large extent on the management of the treated sward. If the management is designed to encourage clover growth, then recovery

can be quite rapid. Under other types of management recovery may be extremely slow.

One outstanding feature about the use of weedkillers on grassland is that by themselves such weedkillers achieve very little. Their use must be part of a planned pasture renovation and improvement programme.

### Weedkiller for use in clover

One of the most interesting recent discoveries in the herbicide field is the phenoxy butyric compounds, of which MCPB is in commercial use in the U.K. Very similar in action to MCPB is 2,4-dichlorophenoxybutyric acid (2,4-DB). The selective action of these chemicals was discovered by Prof. Wain at Wye College and reported to the second British Weed Control Conference at Harrogate in November 1954.

Very briefly, MCPB and 2,4-DB are believed to be biologically inactive in themselves, but may be broken down by enzymes within plants into MCPA and 2,4-D respectively. Not all plants possess these enzymes, and this forms the basis for the selectivity of these chemicals. It is believed that wheat does possess the enzyme capable of converting MCPB into MCPA, but as grasses generally possess a high degree of resistance to MCPA this conversion does not appear to affect the growth of the wheat. Red and white clovers do not seem to have the breakdown enzyme and are, therefore, to all intents and purposes unaffected by MCPB or 2,4-DB.

Lucerne is affected to a certain extent by 2,4-DB and more by MCPB. It is only just over a year since these chemicals were introduced to field testing in the U.K. and the U.S.A. on a wide scale, so it is difficult to draw hard and fast conclusions as to the part which they may play in the field of weed control, but it seems clear that there should be a considerable outlet for them in any pastures where clovers are a vital part of the sward and in cereals undersown with white clover/grass mixtures.

The range of weeds suppressed by MCPB and 2,4-DB is naturally somewhat more restricted than that covered by MCPA and 2,4-D and, as a general rule, it seems that application of MCPB and 2,4-DB should be made at an earlier stage of weed growth than is normally recommended for MCPA or 2,4-D. It must be emphasised, however, that a great deal more work is necessary with these new discoveries before very much can be stated definitely.

### Lucerne

An enormous acreage of lucerne is grown in the U.S.A. and in South America and the general view is that the most serious weed problem is that of annual weeds which compete with the young crop in the early stages of its establishment. In this country and in parts of the U.S.A. dinoseb is used and is quite effective on a wide range of annual broad-leaved weeds, but care is necessary in applying it to achieve success without damaging the crop. The growing conditions before spraying must be such that the weeds are sufficiently ' soft ', but at the same time the crop must be at a stage and in a condition sufficiently resistant to the spray.

In hot countries, *e.g.* Argentina, dinoseb does not commend itself because the high summer temperatures prevailing increase the danger to the operators. MCPA and 2,4-D are of extremely limited use in lucerne. There is thus a gap in our armoury here. 2,4-DB would seem worthy of extensive trial, but little is known about this chemical yet. There is thus much to be done before it can be claimed that the control of broad-leaved weeds in lucerne is a universally solved problem.

Grass weeds in lucerne in the U.K. and U.S.A. have been tackled with chemicals like IPC and CIPC in the dormant season; in the U.S.A. TCA has been used at rates of 10 lb. per acre and above on lucerne in the early spring. The phenyl carbamates have achieved some success against young annual grasses, such as *Poa annua* and *Alopecurus myosuroides*. TCA has checked the growth of several perennial grasses, but has depressed the lucerne yield in the first cut following treatment.

### Weeds in peas

Chemical control of weeds in peas is also a practical proposition. Probably the most useful weedkiller for this purpose is dinoseb (dinitro-*o*-*sec*.-butyl phenol), but its limitations have already been listed in the discussion on lucerne. Dinoseb can control a wide range of annual weeds provided they are sprayed at an early stage, but the stage and state of the crop really dictate the time of application.

MCPA may be used in dust form on marrowfat varieties of peas at up to 2½ lb. of active acid equivalent per acre. As a dust MCPA is probably half as effective as in spray form, so that this rate of application is not so high as it may appear to be. In the U.S.A. and in New Zealand MCPA has been used experimentally in liquid form as the sodium or potassium salt or amine in peas, but this technique is not used extensively in commercial practice. 2,4-D is not safe to use on peas. MCPB has proved safe on certain varieties of peas in the U.K. trials, but again the range of weeds which this chemical will suppress is rather restricted. It is said to be very effective on young shoots of creeping thistle (*Cirsium arvense*), which is a serious weed of pea crops in parts of Britain.

### Woody perennials

The control of woody weeds does not necessarily refer only to the removal of scrub, although this is undoubtedly a quite important problem. In New Zealand, for instance, gorse (*Ulex europaeus*) is a scourge in hill pastures and takes up thousands of acres of valuable sheep and cattle grazing land. At the present moment it is being dealt with to a considerable extent by the application of 2,4,5-T, one of the original group of growth-regulator weedkillers.

Application techniques vary, but in general the standing gorse is drenched with a concentration of around 2–5 lb. of active acid equivalent of the chemical in 100 gal. of water, depending on the age and stage of growth of the gorse. Formulations in general use are esters.

Normal commercial application of 2,4,5-T to gorse is by ground spraying machines, but experimental work is in progress in New Zealand to determine the effectiveness of helicopter application of 2,4,5-T. The limitation of this technique at the moment is the low volume per acre sprayable by helicopter. Brambles have proved susceptible to this chemical and large

acreages of this pernicious scrub weed are being sprayed with 2,4,5-T in Europe, Chile, Australia, New Zealand and the U.S.A.

Several *Acacia* species infesting grasslands of Central and South Africa and Queensland respond to 2,4,5-T applications and some progress is being made with 2,4,5-T in the eradication of ' tsetse bush ' before clearance and colonisation of hitherto tsetse-infested areas in Tanganyika. Obviously, 2,4,5-T is only an ancillary in the reclamation of this type of land, and woody species which harbour the tsetse fly are not all susceptible to the chemical.

Another development of the use of this woody weedkiller is in the removal of weed trees from tropical rain forests. Here slow kill of the offending trees is essential in order to avoid the undesirable effects of rapid loss of shade and in this respect work in Uganda has demonstrated that 2,4,5-T has proved most useful.

*MCPA being sprayed on wheat in Chile, 1955*

## Problems of perennial grasses

Not least in importance amongst world-wide problems is that of perennial grasses, particularly creeping rhizomatous or stoloniferous perennials. Some of the main offenders are lalang (*Imperata cylindrica*), bamboo grass (*Ischaemum muticum*), ' Kans ' grass (*Saccharum spontaneum*), Johnson grass (*Sorghum halepense*), Bermuda grass (*Cynodon dactylon*) and African couch grass (*Digitaria scalarum*).

Different species of *Imperata* are to be found in many parts of the world, including the sub-tropical and warm temperate zones, but nowhere is it more aggressive than in Malaya, where lalang is the bane of the rubber planter. Lalang takes over land that has gone out of cultivation and exists as a nuisance in rubber plantations until the rubber has grown large enough to shade it out.

Chemical weed control has been practised for many years and one of the most common methods still used is that of multiple applications of sodium arsenite, the principle being the constant defoliation of lalang until the rhizome system is eventually weakened. Where ploughing is practicable, lalang can be dealt with in this way, but this is not possible on many Malayan rubber estates. Oils are used on the same principle of multiple application and on ' sheet ' lalang (*i.e.* lalang growing on uncultivated ground) sodium trichloroacetate has proved successful at the high rate of 150 lb. of product per acre. At this rate TCA may seriously injure rubber trees.

Most recent indications from work carried out by the Rubber Research Institute in Malaya are that dalapon (α,α-2:2-dichloropropionic acid) is more effective still. The methyl urea derivatives, CMU and PDU, have not proved very effective on this grass except at very high rates.

The ' Kans ' grass problem in Northern India is being investigated by the Central Tractor Organisation, who are examining chemical and cultural methods of ridding the land of this pernicious grass. CMU and PDU have been tested experimentally and it seems that ' Kans ' responds in much the same way as lalang to these chemicals. Johnson grass, Bermuda grass and African couch are susceptible to TCA and to dalapon, probably more so to the latter.

The main point that has to be considered in the control of weed grasses is the susceptibility of the crops which these grasses infest. For example, African couch may be the main weed problem in sisal, tea and coffee. Johnson grass and Bermuda grass are troublesome in orchard crops, fruit crops and agricultural crops generally. Much study is required concerning the selective application of these grass killers in plantation crops, but at least some encouraging results have been forthcoming from work against *Digitaria* in sisal.

## Couch

In the U.K. the main creeping grass weeds are couch (*Agropyron repens*) and bent or water grass (*Agrostis gigantea*), and TCA is being used on a commercial scale in the autumn to suppress these grasses. The recommended technique is to apply TCA in two doses each of 20 lb. of product per acre. The first dose is recommended immediately following ploughing of the stubble in the late summer. Cultivations should follow treatment and about four or five weeks later a second application of 20 lb. of TCA per acre is applied, followed by more cultivations. Within 12 weeks of the second application the land is considered safe for planting with cereals. Some crops can be planted one month after the second spraying. Results from this technique have quite often been good, but they are rather variable.

## Weeds in vegetables

The chemical control of weeds in vegetables and other row crops, such as sugar-beet and brassicae, is difficult and calls for pre-emergence techniques. Pentachlorophenol is in commercial use in Britain against weeds in sugar-beet and mangolds and in a number of other crops, such as carrots, onions and turnips. The recommended treatment is to spray the weed seed-

lings as they emerge through the ground and before the crop germinates. In practice this can be a rather tricky operation. Much must depend upon growing conditions following the sowing of the crop, but pentachlorophenol is a good contact pre-emergence weedkiller when used under first-class conditions.

### Wild oats

One of the biggest unsolved weed problems of the present is that of wild oats. Millions of acres of cereal land in the U.S.A., Canada and Europe, especially Great Britain, are riddled with this weed and at present there is no acknowledged technique for the control of wild oats in cereals with herbicides. There has been some interesting work carried out in Canada with new chemicals called CDAA (α-chloro-*NN*-diallyl acetamide) and CDEA (α-chloro-*NN*-diethyl acetamide). IPC (*N*-phenyl*iso*propyl carbamate) and TCA are being tested extensively in Britain this year for the removal of wild oats from peas. The technique under test in U.K. consists of applying the chemicals to the soil seven to 10 days before the peas are due to be drilled. The chemicals are then disked in to a depth of 3–4 in. and drilling takes place in the normal way.

Experimental work has shown that a high degree of control of wild oats may be achieved by both of these chemicals, but each has drawbacks yet to be overcome. For example, IPC varies in its effects with different soil textures and soil moisture availability. TCA appears to remove wax from the cuticle of the pea leaf, thus rendering the peas more liable to serious scorch should dinoseb be used following TCA application. However, this sally against wild oats in peas represents an attempt to tackle the weed where it is vulnerable and it may be that in time techniques will be developed for removing wild oats from other crops with chemicals. If such crops can be worked effectively and economically into farm rotations, the chances of freeing the land for cereal crops may be enhanced.

Another problem exercising the minds of many is to discover a non-poisonous substitute for DNC, a chemical similarly effective yet easier to handle, absolutely safe, yet capable of application in low-volume sprayers.

There is certainly much to occupy the time of the fundamental and field research workers engaged in the study of herbicides. Even those problems which we regard as solved can be tackled more efficiently than they are at present and there is a wealth of partially solved and unsolved problems waiting for solution. Throughout the whole of this work, however, the one essential fact to be remembered is that any weedkilling technique, however successful, must be an aid to, rather than a substitute for, good husbandry.

*Photos: Plant Protection Ltd.*

### *Aerial Contract Work*

Fison-Airwork is a comparatively new name in the commercial world, the company having been formed only 12 months ago. Fison-Airwork concentrates exclusively on aerial operations in the two specialised fields of helicopters and slow-flying planes and the company absorbed the aviation section of Fisons Pest Control Ltd., the crop protection specialists and pioneers of helicopter spraying.

Fison-Airwork has just taken delivery of a Westland Whirlwind S.55 helicopter—the first S.55 to be used for this type of work in Britain and the Colonies—as an addition to their present fleet of eight Hiller helicopters. The S.55 can carry 200 gal. of spray chemical, or a 2,000-lb. load, and loads of awkward shapes and sizes can be carried slung beneath the aircraft—an advantage over conventional transport, where shape and size of load usually depends upon the interior capacity of the hold or lorry.

In the U.K. the small irregularly-shaped fields and the numerous obstructions encountered mean that the helicopter is the most efficient spraying aircraft, but in other countries where such conditions do not exist aerial spraying can often be more economically carried out by aeroplane and Fison-Airwork has therefore acquired interests in two other companies owning fleets of spraying aircraft, Airspray (East Africa) Ltd. and Union Crop Sprayers Ltd., of South Africa, and, in addition, the eight Auster aircraft previously owned by Fison-Airwork have been sold to Pest Control (Sudan) Ltd. and are based in that country. This means that Fison-Airwork and its associated companies have today a total of 26 aircraft, namely nine helicopters and 17 sprayplanes. The periods of intensive spraying operation in Africa vary in the different territories concerned and now that the companies belong to one group they are able to lend aircraft to one another, making it possible to concentrate larger fleets where and when they are required and also to achieve more economic utilisation of aircraft.

*Apart from its agricultural uses, the Fison-Airwork helicopter* (left) *can undertake other industrial aerial work; it is particularly suitable for engineering and geological projects*

# ECONOMICS OF WEED CONTROL WITH SPECIAL REFERENCE TO MCPA

C. P. HAMPSON, B.SC., M.I.BIOL.

(*British Schering Limited*)

*The effects of weeds in the world's agricultural lands are manifold. Because of them crop yields are reduced, labour costs are increased, the quality of crops is impaired, the incidence of pests and diseases of crop plants is often increased by their presence, land value is depreciated, they may impair the health of humans and stock. These and other disadvantages caused by the presence of weeds can be overcome with proper control methods. The author discusses these points and enlarges on the economics of weed control.*

IN his agricultural pursuits, from the earliest times of his existence, man has had to contend with certain undesirable species of plants. Such species, unwanted, useless, often prolific and persistent, interfere with agricultural operations, increase labour, add to costs and reduce yields. These obnoxious plants are known as weeds. A more simple definition of a weed is ' a plant out of place '. An agricultural writer of the last century (William Darlington, 1859) wrote that ' . . . the labours of the agriculturist are a constant struggle. On the one hand, by presenting the most favourable conditions possible, he endeavours to make certain plants grow and produce to their utmost capacity; on the other hand, he has to prevent the growth of certain other plants that are ready to avail themselves of these favourable conditions '.

In spite of the fact that losses caused by weeds far exceed the losses caused by any other group of agricultural pests, including insects, diseases and rodents etc., and may in actual fact exceed the combined losses caused by all the other agricultural pests together, the true significance of these losses is seldom realised.

Weeds cause direct losses to farmers in the following ways:

(1) *They reduce crop yields*

All plants require a certain amount of nutrients, water, light and space for growth. The heaviest loss caused by weeds results from their competition with crops for these essential requirements. For example, if 10 surface inches of water are necessary to mature a grain crop in a certain locality and because of competition for water only five are available for the crop, the yield will be seriously reduced even though mineral nutrients are available in abundance and shading has not impaired growth of the crop. Weeds are generally vigorous plants and their demands for mineral nutrients are great. Charlock, for instance, needs twice as much nitrogen, twice as much phosphoric acid, four times as much potash and four times as much water as a well-developed oat plant.

Numerous reports have been published concerning the effects of weed competition in wheat. In 1930 Korsmo[1] published a classic paper on the effects of various methods of weed control in cereals and showed that as a result of spraying with sulphuric acid an increase in yield of 25% was obtained. Pavlychenko and Harrington[2] compared the yields of wheat from clean and weedy land infested with charlock and noted a difference in yield of 40%. They also showed that wheat containing seven sow thistles per sq. ft. experienced a loss in yield of 71% compared with wheat free from sow thistles.

Differences in yields of grassland due to weeds are more difficult to assess than in arable crops, but Willis,[3] at the Hertfordshire Institute of Agriculture, has shown that after spraying grassland with MCPA he was able to secure a more complete utilisation of the available herbage, the difference amounting to an average of 4.6 cwt. of dry matter per acre between the sprayed and the unsprayed treatments largely as a result of the control of creeping buttercup. He estimated that the value of the additional herbage was worth about twice as much as the cost of applying the weedkiller. Similar

*A typical low-volume sprayer used for the application of MCPA solutions at application rates of from 5 to 20 gal. per acre*

results were obtained by Templeman and Halliday,[4] who have shown that an autumn application of MCPA, coupled with correct fertiliser application, increased the yield of edible herbage by 5.2 cwt. of dry matter per acre as estimated by cuts taken in the following summer. Allen and Ochiltree[5] have reported that creeping buttercup, crowfoot, creeping thistle, common rush and even ragwort may be considerably reduced by MCPA treatment and that, with good management, the advantageous effects obtained from the spraying of permanent grassland with one application of MCPA at 1½ lb. of acid equivalent per acre (5 pints of 30% MCPA solution) will persist for at least two years after the treatment.

There are more than 13 million acres of permanent grassland in this country, much of which could be considerably improved by good management techniques embracing the use of MCPA. Many farmers are aware of the benefits to be derived from these treatments and no doubt more grassland would be sprayed if capital was available to exploit fully the greater production from these improved grasslands. More grazing need not, however, mean more capital outlay on extra stock, for with good management the same stock can be put on a smaller acreage of grassland, so releasing a portion of this acreage for other use. Although our grasslands present considerable scope for the use of weedkillers, by far the greater proportion of all crops sprayed at the present time with MCPA weedkillers are arable.

(2) *Weeds increase labour costs and cause difficulties at harvesting time*

Cereal crops infested with weeds require extra labour to harvest and, apart from the additional labour costs, the presence of weeds causes breakages, stoppages and extra depreciation of harvesting machinery. Indeed, it has been claimed that the use of the combine harvester is only efficient when it is coupled with the use of selective weedkillers.

(3) *Weeds impair the quality of farm products*

A large number of weeds in hay or stooked grain will retard drying, with the result that moulds may start. The market value of wheat may be greatly reduced if certain weeds are present. For such weed seeds as mustard, ragweed and corn cockle, even in small quantities, cause objectionable odours and flavours to the flour if they are ground with the wheat. Certain weeds, such as wild garlic, buttercup and runch, impart an undesirable taint to the milk of those cows that graze upon them. The seeds of certain weeds may become so entangled in the hair of animals that they reduce the value of the wool or hide. Added to these losses is the reduced carrying capacity of grasslands resulting from weed infestation.

(4) *Weeds harbour insects and fungus pests that attack crop plants*

In addition to the directly harmful effects detailed above, weeds present other dangers as ' host ' plants for a variety of fungus diseases and insect pests. If brassicas are grown too frequently, serious losses may result from club root disease and flea beetle attack; thus if such cruciferous weeds as charlock, shepherd's purse and pennycress are not controlled, they may harbour pests and diseases which attack subsequent brassica crops. Annual sow thistle is the host plant of currant and lettuce aphis and bean thrip. Creeping thistle and scotch thistle may be host plants for mangold fly, bean aphis, and they are believed to encourage cockchafers, crane flies and wireworms. Docks are hosts of the mangold fly, bean aphis, crane flies and wireworms.

It is perhaps true to say that if weeds could be eliminated some of our worst crop pests could be easily controlled.

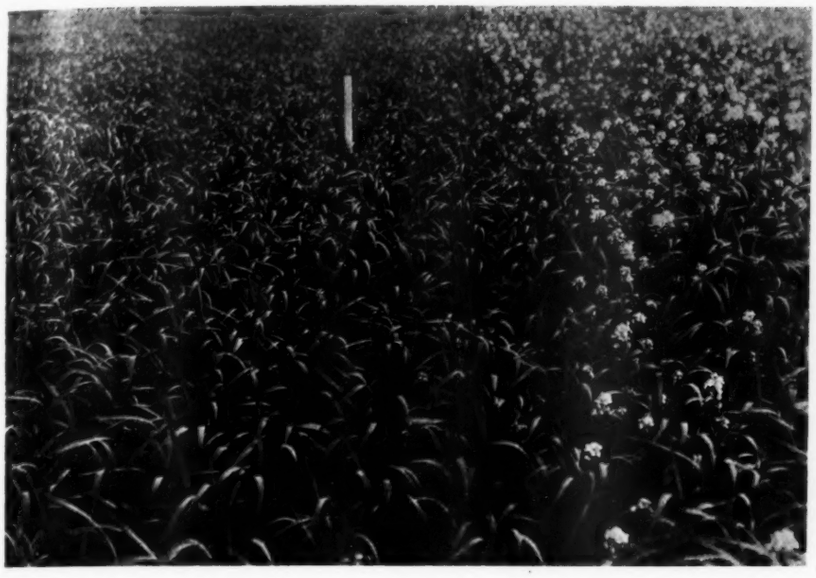
(5) *Weeds cause depreciation of land values and can reduce farm loans*

Land heavily infested with perennial weeds has a reduced sales value and banks have been known to refuse to loan money on lands heavily infested with St. John's wort, knapweed or hoary cress.

(6) *Some weeds may impair the health of human beings and animals*

Illness and deaths due to plant poisoning occur all over the world and, although losses of livestock from this cause are quite considerable in Britain, they are in reality very small when compared with the enormous losses from this cause sustained by many of the more recently developed countries. In Britain, tradition and folklore, as well as the development of scientific methods, have played their part in ridding a large part of the country of such noxious weeds as corn cockle and darnel.[6] Ragwort is an all too serious menace of grassland, however, and probably because it is not normally grazed by cattle, it is not generally recognised that this weed is poisonous. On the other hand, the weed may be

(Left) *An untreated plot infested with thistles;* (right) *a plot treated with MCPA*



*Charlock controlled in wheat with MCPA used at the rate of 4 oz. per acre*

included in hay with disastrous results. A word of caution is, however, necessary before grazing fields containing ragwort after spraying with MCPA. This is because weeds, which are not normally consumed by cattle, seem to become more palatable after treatment with ' hormone ' weedkillers. For this reason fields containing ragwort should not be grazed after spraying with MCPA until this weed loses its temporary palatability and dies back.

(7) *Weeds can cause a loss in social prestige*

In some parts of the country any farmer who has much charlock or poppy in his cereals becomes the subject locally of caustic comment.

Briefly summarising the reasons for weed control, it can be stated that the smaller average farmer will expect an increased return from the extra cost of chemical weed control and the larger combine farmer will expect to reduce his labour by easier combining, as well as to increase his yields by spraying.

## Balance of nature

In the past there has been a good deal of muddled thinking about the balance of nature. This was commented on by the President of the first British Weed Control Conference at Margate in 1953, when he remarked that the farmer spends his life upsetting the balance of nature and must continue to do so unless we decide to live on acorns, grass seeds and rabbits. He added that it is the biological balance of the farm, an artificial balance, that is of importance, and that in many cases herbicides are affecting this balance obviously for the better.[7] For example, we have already considered the part that weeds play as ' alternate hosts ' in propagating crop pests and diseases, and in particular how the control of charlock in cereals helps to prevent the spread of club-root disease and flea beetle of brassica crops. Fortunately, however, people are a little more enlightened these days and cries about this disturbance of nature are not so loud and, by and large, progressive farmers are unanimous in the view that weedkillers are, or can be, of immense value towards the aim that they are struggling to achieve—higher production with lower costs and, in particular, with a saving in manpower.[7]

## Economics of weed control

Returning now to consider the benefits and economics of weed control in more detail, it should be explained that the yield increases used in the following calculations have been based on the results of trials and experiments conducted by Prof. Blackman at the University of Oxford. Blackman reported that ' viewed as a long-term policy, selective weed control will ultimately lead to cleaner crops, but from the short-term aspect its immediate return in crop yield is the most important financial consideration'.[8] From the results of his experiments with MCPA over a number of years, he claimed that the average gain in yield of grain was 23%. From time to time yield increases of 100% or even 200% have been claimed as a result of weed control, but in these cases the control yields must have been abnormally low.

Discussing the cost of weeds and potential value of herbicides at Margate in 1953, Holmes[9] considered that from all the evidence available it was fair and conservative to take a 20% grain yield increase as an average figure to apply when MCPA is used at adequate rates of application.

By using this figure of 20% grain yield increase and assuming that the farmer will do his own spraying, using an ordinary hydraulic low-volume sprayer costing in the region of £50 and allowing

(1) annual depreciation at 25%
(2) that 25 acres can be sprayed per 8-hour day
(3) tractor operating costs at 3s. 3d. per hour
(4) wages at 2s. 11d. per hour.

the cost of the application per acre, assuming that the farmer has 75 acres to spray altogether in his ' season ', may be calculated as follows:

| | £ | s. | d. |
|---|---|---|---|
| Annual depreciation at 25% .. | 12 | 10 | 0 |
| Total time spraying (at 25 acres per 8 hours) = 24 hours Tractor and labour costs at 3s. 3d., plus 2s. 11d., *i.e.* 6s. 2d. per hour .. .. | 7 | 6 | 0 |
| Total .. .. | £19 | 16 | 0 |

*i.e.* 5s. 3d. per acre.

In addition to the operating cost of 5s. 3d. per acre, there is, of course, the cost of the weedkiller.

Assuming that Raphone, a 30% MCPA weedkiller solution, is used at the top rate of 5 pints per acre, the total amount required to control the weeds in the farmer's 74 acres of cereals is approximately 47 gal. Based on farmers' prices of 31s. 0d. per gal. for last season, this represents a total cost of £72 17s. 0d. or a cost per acre of 19s. 5d. It should be pointed out that in the case of such weeds as charlock, pennycress, treacle mustard, wild radish and other susceptible weeds good control would be obtained using Raphone at 2 to 2½ pints per acre, in which case the cost of the weedkiller expressed on a per-acre basis would be 7s. 10d. to 9s. 9d.

The total costs per acre involved,

*A quadrant used for making weed population counts*

using Raphone at the top rate, *i.e.* to give control of the more resistant weeds, such as thistles and docks etc., would be 19s. 5d. for the Raphone plus 5s. 3d. for operating cost, a sum of £1 4s. 8d. per acre.

It is usually considered that the farmer will measure the value of a chemical weed-killing operation primarily in the light of the relationship between the expenditure involved in the application of the weedkiller and the increased return obtained in terms of grain yield.

Benefits to be gained from this expenditure on weed control must, therefore, be considered. Official estimated yields and average guaranteed cereal prices for 1955 are as follows:

| *Crop* | *Average yields (cwt./acre)* | *Price per cwt.* |
|---|---|---|
| | | s. d. |
| Wheat | 24.4 | 30 0 |
| Barley | 23.7 | 24 8 |
| Oats | 20.7 | 23 3 |

Applying a 20% increase in yield to these figures, the following yields after spraying and gross profits per acre are obtained:

| *Crop* | *Yield after spraying (cwt./acre)* | *Increased gross profit per acre* |
|---|---|---|
| | | £ s. d. |
| Wheat | 29.3 | 7 7 0 |
| Barley | 28.4 | 5 15 11 |
| Oats | 24.8 | 4 15 4 |

On this basis the *net profit per acre* to be expected (based on 1955 prices) as a result of spraying with Raphone is as follows:

| | £ s. d. | | £ s. d. | | £ s. d. |
|---|---|---|---|---|---|
| Wheat | 7 7 0 | less | 1 4 8 | = | 6 3 4 |
| Barley | 5 15 11 | less | 1 4 8 | = | 4 11 3 |
| Oats | 4 15 4 | less | 1 4 8 | = | 3 10 8 |

With a susceptible weed like charlock the application costs would be in the region of 7s. 10d. for Raphone, plus 5s. 3d. for operating costs, *i.e.* 13s. 1d. per acre. In this instance the net profit per acre resulting from the control of these susceptible weeds in wheat would be £6 13s. 11d.

In spite of the fact that large acreages of cereals are sprayed every season, no statistics are needed to prove that a considerably larger acreage of cereals is not treated—the aspect in spring and summer of too many British fields up and down the country is only too revealing. At the British Agricultural Contractors' Association meeting in 1952 it was reported that losses due to weeds in Great Britain alone amounted to something in the order of £50 million.[10]

On the other side of the Atlantic, Dr. Stahler, a well-known authority on weeds in the U.S.A., stated that even with the advances agricultural chemistry has made in helping to control weeds, the annual losses to farmers in the U.S.A. is still estimated at $36 billion (£11,000 million).

MCPA has a very big part to play in the cutting down of these losses.


REFERENCES

1. Korsmo, E.: 'Umkrauter im Ackerbau der Neuzeit', 1930, p. 546.
2. Pavlychenko & Harrington: *Sci. Agric.*, 1935, **16**, 151.
3. Willis, S. J.: *Agriculture*, 1950, **57**, 359.
4. Templeman, W. G., & Halliday, D. J.: *Emp. J. exp. Agric.*, 1951, **19**, 104.
5. Allen, H. P., & Ochiltree, W.: *Agriculture*, 1953, **60**, 412.
6. 'British Poisonous Plants', Ministry of Agriculture Bulletin, No. 161.
7. Scott Watson, (Sir) James A.: Proceedings of British Weed Control Conference, 1953.
8. Blackman, G. E.: *Agriculture*, 1946, **53**, 16.
9. Holmes, E.: Proceedings of British Weed Control Conference, 1953.
10. Woodford, E. K.: British Agricultural Contractors' Association Meeting at Oxford, 1952.


## Rubber Replanting Plan

The Federal Legislative Council of Malaya gave approval in May 1955 for the expenditure of $M280 million (1$M = 2s. 4d.) on a scheme to encourage the replanting of rubber estates and smallholdings; formal regulations for sharing the sum of $M168 million amongst the estates were announced in Kuala Lumpur on 2 January, 1956.

Estates claiming grants will have to satisfy the grant authority that they are planting approved high-yielding rubber trees and following good agricultural practice. Grants will have to be applied for annually and a total not exceeding $M400 per acre may be granted over a five-year period.

Regulations for the disbursement of the $M112 million allocated for improvement of smallholdings will be announced later. It was announced in October 1955, however, that $M5 million of the money would be allocated for the establishment of a stock of planting material in order to ensure that adequate supplies are available to all smallholders, and that a further $M22½ million would be set aside for additional assistance to smallholders with less than 30 acres of rubber-producing land.

### Private development

The Dunlop Rubber Co. announced in December 1955 that £5½ million would be spent between then and 1962 on modernising and developing their 80,000 acres of rubber estates in the Federation. The company also plans to manufacture latex foam products at a factory at Bahau in Negri Sembilan. It is expected to be in production shortly.

# WEEDS

## A LIMITING FACTOR IN TROPICAL AGRICULTURE

D. G. ASHBY, M.A., and R. K. PFEIFFER, PH.D.
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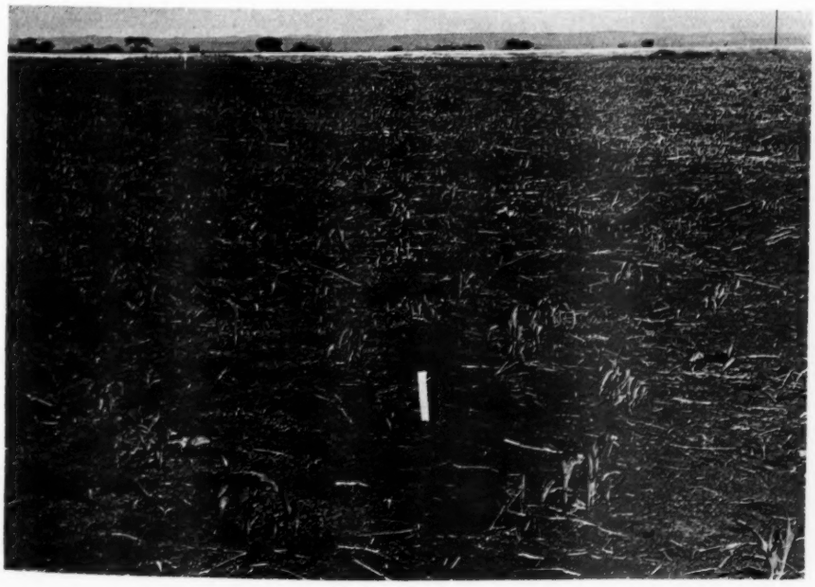
*The terms 'tropical', 'sub-tropical' and 'temperate', applied to types of agriculture, are necessarily generalisations, but certain comparisons can be made concerning their weed problems. The authors discuss this question and a new-type spraying machine that will be of help to many agricultural officers working in the tropics.*

IN the tropics and sub-tropics the weed problems are in many cases of a different order from those in the temperate zones. Some measure of this is seen by comparing the differences in the speed and size of regrowth of vegetation on bare ground in the two types of climatic zones. The effect of this difference on the growth of a crop is very marked; in fact, in temperate climates it is in many cases possible to grow a quite profitable crop without any weed control at all, whereas in tropical and sub-tropical areas weed control may be essential if any crop is to give an economic return. Examples of this have been found among cereals in Kenya, with newly-transplanted sisal in Tanganyika and with maize growing in competition with nut-grass in South Africa.

### Yield increase

The age of the arable land also has an effect on the need for weed control in the two types of climates (temperate and tropical/sub-tropical). Land that has been cropped and cultivated for perhaps many hundreds of years gives the crop a better chance of growth than land newly cleared from bush or forest, as is often the case in, for example, large-scale plantation enterprises. This difference relates to the weed problem only and would not apply with, for example, fertility.

A further difference is shown by comparing the effects of removing the competition of weeds with the crop—the effects of weed control on the crop yield. In the temperate zones (again generally speaking) the yield increases are of the order of 25%, whereas in the tropics/sub-tropics yield increases of 100%, or even more, result very frequently from weed control by proper methods.



*Young maize, showing a high density of young weeds on the unsprayed part* (left) *of the field. Central Africa*

### Many difficulties

So far we have merely enlarged on what is common knowledge to anyone with experience of tropical agriculture. In practice, though, successful weed control is made difficult by a number of causes. It may be the nature of the terrain, which effectively prevents mechanical cultivation; or the soil may be unsuitable for using heavy mechanical equipment; or no effective mechanical means may be available. Hand weeding—by hand pulling the weeds or by the use of heavy native hoes—is a slow business and is usually done *after* the weeds have begun to exert a depressant effect on the crop yield.

Many weed problems in the tropics and sub-tropics cannot be dealt with effectively by hand methods—for example, lalang and khans grass and other perennial grasses.

There is now a lot of evidence that the answer to many of the tropical/sub-tropical weed problems lies in the proper use of herbicides, which can be more selective and thorough in their action than cultural methods, and which can be applied at an earlier stage in the development of the crop, even before the crop emerges from the ground.

Can the tropical and sub-tropical crops carry expenditure on chemical weed control? Rather can the farmers of the tropics and sub-tropics afford not to use herbicides where chemical weed control methods have been developed, in view of the large increases in yield that can result from thorough weed control?

As labour costs rise, weeding by hand becomes more and more expensive. Not only do labourers' wages loom large in the expenditure, but also the overheads spent on food, housing and medical attention; and the cost of housing labourers is a particularly large item in the economy of many plantation crops today. Such a trend of rising costs means that maximum crop yields must be obtained, and with the minimum of expense.

And for the peasant farmer, with no labour costs or overheads, the justification for adopting chemical weed control lies in the better job it may be able to do for him than his present methods. We say ' may ', for there are countries where exceptions may be found.

## Knowledge and equipment

Two questions now arise: firstly, is there sufficient scientific knowledge of the weed problems in the tropics/sub-tropics and of their solution by chemical methods? Secondly, is this knowledge extensively enough applied in practice and the techniques of chemical weed control widely enough known by those who will benefit most?

There is a certain amount of scientific knowledge of the problems, or knowledge that can be applied to those problems, but more is needed, and the dissemination and application of this knowledge could be much more widespread. And then there is the matter of supplying the tools for the job—the chemicals and application equipment. But first the demand for these must be created by a knowledge of chemical weed-control methods and the advantages of putting them into practice.

## Limiting factors

Why, then, is the knowledge and practice of chemical weed control not more widespread in the tropics and sub-tropics?—often lagging behind the chemical control of insect pests and fungus diseases? This may be partly explained by the fact that, whereas weeds can to a certain extent be dealt with by hand-control methods—even on a large scale—this is not generally the case with pests and diseases. Furthermore, the effects of pests and diseases are usually clearly seen, especially in outbreaks in tropical and sub-tropical climates, and the damage done is very evident. There is no doubt about their importance as factors severely limiting profitable crop production. There are naturally other limiting factors—rainfall, soil fertility and so forth—varying from one region to another. But if an assessment of limiting factors were made for the major crops of a number of tropical and sub-tropical countries, it would probably be surprising in how many instances the weed problems would be the factors that either limit the yield of the crop or are a major item in the cost of production.

*Bush vegetation impeding filariasis control measures (Ceylon)*

Such an assessment would also show that many tropical weed problems have a lot of points in common—more in common than they have differences—for example, selective control of annual grasses, control of perennial grasses and the control of nut-grass.

## Research and development

A brief consideration will show that the allocation of research and development in the tropics and sub-tropics amongst pest-, disease- and weed-control problems is not in proportion to the importance of each group as limiting factors. The research and development effort is unbalanced, with chemical weed control receiving too small a share. And research and development work must precede the establishment of chemical weed-control methods on a field scale.

One reason for this unbalanced effort is that chemical weed control is a young science and there is a shortage of experienced weed-control investigators. For example, in Africa there are far too few weed-control experts in proportion to the number and scale of the problems there. There is certainly a need for more agricultural students to concentrate on weed control.

If it is assumed that the government of a region has made an assessment of the limiting factors in the production of a certain crop, and has established that weeds are a limiting factor and their control a matter of prime importance, what is the next step? Many of the weed problems of the tropics and sub-tropics are common to a number of countries and this is a fact which must be seized upon and made the maximum use of. For instance, liaison between scientists confronted with the same weed to control cannot start too soon, so that a common and concerted attack can be made on the problems. The man, or team, working on the control of nut-grass in rice in India, another working on the same weed in cotton and irrigation canals in the Sudan, or in maize in Southern Africa, or in pineapples in East Africa—these have everything to gain from co-operation in at least the initial stages of the work. International co-ordination at the level of individual weed problems could advantageously be extended. Such co-operation in an organised form could cover such problems as:

(1) selective control of annual and perennial grasses, *e.g.* in maize, rice, sugar-cane, pineapple, coffee, tea, sisal, rubber, citrus, groundnuts and cotton;

(2) bush clearance and area problems such as control of lalang and khans grass;

(3) control of aquatic weeds—in swamps, paddy fields, irrigation canals, lakes, tanks etc.

Some of these problems are particularly likely to be encountered in new agricultural development schemes.

### Widespread trials needed

Let us finally consider the position of an agricultural officer in a tropical country whose government has decided to attack the weed problems by modern methods and has placed him in charge of the project. His task is certainly no easy one, especially if he has to start at the bottom, which would be the case if no experience with modern herbicides were available in this country.

It is suggested that it would be the wrong approach to confine trials with herbicides to a few areas only and to carry out on these sites complex and intricate experiments with many replicated plots. Although as a result of such a method the best herbicide and the optimum dose rate could be found, and the latter determined very accurately, such a result leaves the investigator without any evidence on how reliable this dosage would be under the whole range of conditions where the weed problem exists.

This difficulty can be overcome by doing the experiment not on a few, but on perhaps 100 sites all over the region and thus determining the treatment that is most reliable under all the different conditions encountered. But it is clear that such a task would involve so many research teams and so much expenditure as to make it impracticable.

A new spraying machine for experimental work has recently been developed at Chesterford Park Research Station, a machine which enables these difficulties to be overcome to a large extent. It allows the investigator faced with such weed-control problems to approach them on the 'extensive' basis described above and to make a reliable assessment of the performance of a herbicide in the minimum of time.

*Weeds in dura* (Sorghum) *in the Sudan, showing sprayed and unsprayed strips*

This machine, which has been described in *Nature*, can be mounted on a Land Rover, Jeep or tractor, that also supplies the power for the sprayer. The machine sprays over a plot (5 yd. × 40 yd.) a continuously decreasing dose of the herbicide at constant volume and pressure. For this operation only one solution of the chemical has to be prepared and the machine is self-cleaning, washing out automatically at the end of each run. From start to finish one test with one herbicide can be carried out in 10 minutes (including all preparations) with a dosage range of, for instance, from 8 lb. per acre, continuously decreasing to 1 lb. per acre. By measuring the distance from the start of the spraying to the point at which the desired degree of weed control is found, the dose of herbicide applied can be read from a simple table. Practical experience has shown that one man can spray 20 to 30 such plots in a day provided not too much time is spent in travelling from one site to another. Not only the most effective dose for control of the weeds can be determined, but also the degree of selectivity in the crop, both in the one experiment.

Here is a method by which our agricultural officer can spray 50 or 100 experiments on different sites. From the results he finds the optimum dosage for each site, considering both herbicidal effect on the weeds and the selectivity to the crop, and uses the mean of these optimum dose rates to serve as an 'overall recommendation'. The reliability of this overall or mean dosage is also known from the percentage of sites at which the mean dose gave a satisfactory result.

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## Technical News

Articles included in the June issue of *Dairy Engineering* are 'The Preparation of Bulk Starter in a Cheese Factory' by H. R. Whitehead and 'Cleaners for Aluminium Dairy Plant' by W. A. Wright, B.SC.

The June issue of *Fibres* (*Engineering & Chemistry*) includes articles on 'Wood Oils' by J. K. H. McArthur, A.R.C.S., B.SC., and 'Radioactive Isotopes and Their Use in the Textile Industry—II' by H. E. Knobil.

*Petroleum* for June contains articles on 'Calibration of Oil Storage Tanks and Tank Vessels', 'The Significance of Laboratory Tests in an Oil Refinery' and 'Recent Trends in Oil Geology'.

The contents of *Paint Manufacture* for June will include articles on 'Antifouling Paints Progress—II' and 'Instruments for the Paint Industry'.

Among articles appearing in the June issue of *Corrosion Technology* are 'Corrosion Problems of Sulphuric Acid Plant' by G. C. Lowrison and F. Heppenstall, 'Corrosion of Packaged Articles' by F. A. Paine and 'Spread of Protection' by John Morgan.

# Spraying Machines for the Small-scale Farmer

A. C. TUNSTALL, B.SC.

(*Mycologist, Indian Tea Association* 1911–48; *Technical Advisor, W. T. French & Sons Ltd.*)

*With modern crop-protection systems it is often possible to prevent failure without prohibitive expenditure, providing suitable application equipment is available. The author sets out to describe apparatus of this type that is both simple and cheap; both these attributes are necessary in equipment designed for the small-scale farmer, who may reside in remote, out-of-the-way areas.*

GREAT advances in crop protection material have been followed by considerable improvement in the larger types of equipment for their application. The smaller kinds, operated by hand, have not advanced much since the days of Vermorel, yet a large amount of the world's food is produced on very small plots. Only on a comparatively small percentage of these plots is it possible to use large equipment, and even then it is obvious that such work can only be undertaken by large organisations. Most of the areas are too small and scattered to be treated efficiently with large machines. Moreover, the owners are too poor to buy expensive apparatus and too ignorant to use it effectively.

By far the largest area of small-scale agriculture is in the tropics, where the failure of a crop may mean famine and death. With modern crop-protection systems it is often possible to prevent failure without prohibitive expenditure, providing suitable application equipment is available. Such equipment must of necessity be simple and cheap. A possible reason for the slowness with which new machines of the manually operated type have been developed may be that most of such sprayers on the market are made ' one at a time ' by craftsmen in small workshops, and it is well-nigh impossible to reduce costs to the necessary extent. It is essential to redesign the apparatus so that large-scale production methods may be used. This change involves expenditure that most of the present manufacturers hesitate to undertake. Progress in this direction has therefore been very slow.

*Compression sprayers for cocoa farmers. Before the departure of Col. H. P. Low, managing director of W. T. French and Son Ltd. (second from left), to inspect local arrangements for the servicing of ' Mysto ' machines*

## Standardisation of components

The standardisation of component parts, essential to large-scale production, makes it possible to produce series of models suited to a wide range of conditions without any serious addition to costs. A further advance that is long overdue is the standardisation of discharge equipment to ensure interchangeability. An outfit designed for a specific purpose can, without much additional expenditure, be modified to meet many other requirements.

## Materials and design

It is very important that materials used in the containers and pumps be resistant to damage from any of the fluids it is intended to use. After much observation and experiment the writer is of the opinion that brass is the best metal for the purpose. It is easy to repair and not liable to crystallise, so long as the manufacturing methods are suitable. Aluminium is not so reliable and, like stainless steel, cannot be repaired without special apparatus. The earliest containers and pumps were made of copper because they were used solely for the application of fluids containing copper. The advent of fluids containing sulphur ruled out the use of copper, as the latter is seriously damaged by sulphur components. Carefully selected brass with electrically welded seams has been found to provide the light weight, strength and resistance to corrosion required for pressurised containers.

For many years rubber valves and hose pipes were found satisfactory, but the use of oils and hydrocarbons of various kinds as solvents has made it

necessary to substitute oil-resistant rubber-like substances. The most frequent sources of trouble in all kinds of spraying apparatus are the washers. Much experiment has been necessary to find the best kind of material for washers and the best way of using it. Very few makers pay sufficient attention to this problem. The ignorance of some manufacturers of hand-operated spraying equipment is most apparent in the discharge equipment supplied with their machines. Most of those responsible for the design of spraying outfits have no first-hand knowledge of the uses to which their apparatus will be put. The makers and distributors of spray material, however, have a vital interest in their application and are now rendering very valuable assistance in ascertaining the real requirements—a service the users are often unable to do for themselves.

The selection of the best type of nozzle orifice for the job in hand has been ably emphasised in Coursheе's articles (World Crops, 1953, **5**, 109, 321; 1954, **6**, 439, 485; 1955, **7**, 20) and further developments along the lines he has suggested are being made.

## Simplicity essential

The importance of selecting the machines and accessories most suitable for the work in hand is too obvious to require emphasis, but the need to keep such equipment as simple as possible is not so apparent. It is, however, a common failing to seek greater efficiency by the addition of special devices—these often introduce more things likely to go wrong.

## Syringes

Garden syringes are among the oldest kind of spraying apparatus. These can be made very cheaply, but in their original form they are wasteful of spray material. Considerable modifications have now been effected, enabling fluids to be drawn in easily and projected through a suitable spray jet. An exceedingly simple valve of this kind has been produced cheaply enough to be distributed free by the makers of crop-protection materials and simple enough to be fitted on to a locally made syringe or even a bamboo squirt. With such a valve anyone can spray his crop if he can afford to buy the spray fluid necessary.

An advance on the common garden syringe is the self-supplying syringe through which the fluid is sucked in through a tube. There are a number of these machines on the market, some of which are double-acting and provided with an air container to keep the pressure more or less steady. By using appropriate jets much good work can be done with such apparatus. A further development of the syringe type of machines is the provision of a knapsack container to which the suction hose is attached.

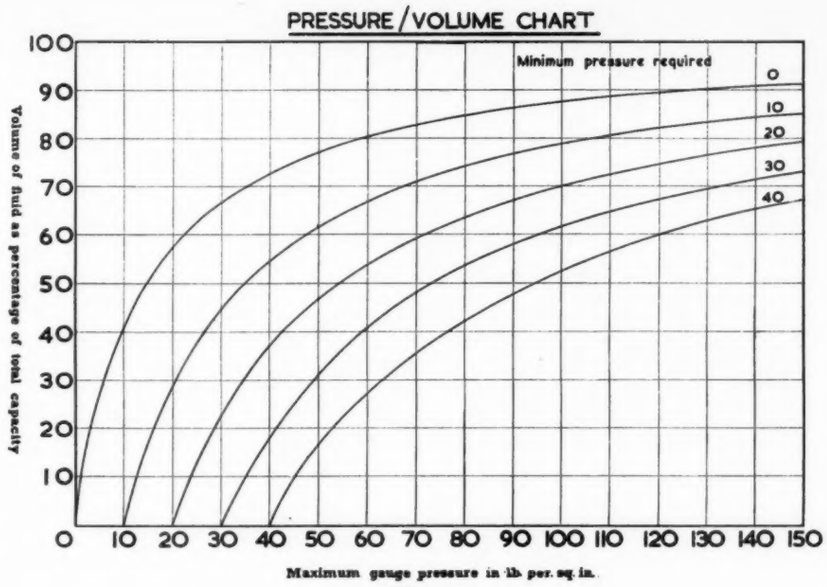



*Fig. 1*

## Stirrup pumps

Another development from the syringe pump is the stirrup pump, so commonly used for fire-fighting during the war. Modifications of this pump are fixed to buckets and tanks. When suitable leverage is applied to the plunger larger volumes and higher pressures can be obtained and a number of jets may be supplied from one pump. It should be remembered that one person is required to operate the pump, while others direct the jets. However, when comparatively small areas are involved the cost of the actual labour would be much less than that involved in the use of power plant.

*A wide-angled spray from a compression sprayer*

## Boom sprayers

The increasing use of weedkillers has made it desirable to have some kind of boom sprayer even on a small farm. A kit of parts is now on the market that enables a boom to be built up very cheaply for attachment to a farm cart. A spray pump fitted to a tank of suitable size, mounted in the cart, will supply the fluid to the boom. Parts are also available permitting the use of the boom for spraying between rows of plants.

## Knapsacks

From the self-supplying syringe with a knapsack container it is but a step to the attachment of the pump to the container and operating it by means of a lever. This type of machine was invented very many years ago and there are two arrangements—one operated by a piston and the other by a diaphragm. Later developments of

*A 'Mysto' combined cut-out, strainer and pressure-control valve in use with a compression sprayer*

this type of machine have been in the provision of larger air containers to enable a steadier flow of fluid to be maintained and to make it unnecessary to operate the pump lever continuously. The provision of a stirring apparatus for the application of suspended solids is often included.

One of the latest machines of this type is illustrated. With this machine a pressure of 120 lb./sq. in. can be maintained without undue effort, and by using a reducing valve to prevent the pressure at the jet exceeding that required to produce a satisfactory spray pattern much fluid can be saved and pumping reduced to a minimum.

### Pneumatic sprayers

Considerable attention has been paid to the development of pneumatic sprayers, because the system allows undivided attention to be paid to the direction of the spray jets. In these a part of the container is filled with air under pressure, the expansion of which forces out the fluid. A well-made container is essential for this class of sprayers, as it is subject to considerable pressure. The usual method of operating pneumatic sprayers is to partially fill the container with fluid, then charge with air from an air pump or an air line.

The spray jets cannot, however, produce a good spray pattern if the pressure falls below a minimum characteristic of the jet being used. It is, therefore, necessary to keep the pressure of the air in the container above this minimum. At the same time, it should be noted that emission at pressures much above the minimum wastes fluid. With sprayers small enough to be carried in the hand or on a single shoulder strap the best results are obtained by filling the container two-thirds full, then keeping the air pressure sufficiently high to maintain a good spray pattern with the jet being used. This is quite easily done with smaller machines by pumping a few strokes at intervals.

It is necessary to carry the larger machines—total capacity 4 gal. or over—on the back and unshipping them for pumping wastes time. It is usual, therefore, to adjust the volume of fluid and the air pressure so that the whole of the fluid is emitted while the air pressure in the container is still high enough to produce a good spray pattern at the jet. A high pressure at the beginning of the emission is unavoidable, but the effect of this can be avoided by using a control valve.

### Proportion of fluid required

The graph (Fig. 1) enables the most convenient volume of fluid and pressure of air to be ascertained for the particular jet. When a hand pump is used directly, *i.e.* without any lever, the maximum pressure that can be obtained without undue effort will depend on the area of the end of the plunger.

The best way is to find out this pressure by trial. The minimum pressure necessary for the jet in use determines the choice of the curve in the graph—at that pressure there would be no fluid left in the container. Select the vertical line corresponding to the maximum pressure that can be obtained conveniently; where this crosses the selected curve indicates the proportion of the total volume of the container that may be filled with fluid when charging.

For example, with a nozzle requiring 20 lb./sq. in. minimum pressure, and the maximum pressure obtainable is 70 lb./sq. in., it will be seen that the initial volume of fluid should be 60% of the total volume of the container.

### Pressure-retaining sprayers

The pumping of air with a hand pump is not difficult until the pressure rises above 30 lb./sq. in. At higher pressures, owing to the compressibility of air, it is much less efficient than the pumping of fluid at the same pressure.

To meet this difficulty a floating valve that closes when the fluid is almost exhausted and retains the remaining air under pressure is provided in some machines. An initial charge of air corresponding to the minimum required by the jet in use is given and followed by pumping in fluid. The container is subsequently recharged by pumping in fluid up to the most convenient maximum pressure. By reference to Fig. 1 the volume of fluid within the container may be ascertained from the pressure on the gauge.

### Battery outfits

Where there is work for a group of pneumatic sprayers, much time and labour may be saved by using a specially designed pressure-retaining container and charging them with a large efficient pump. This type of outfit is known as the 'Battery', usually eight to 12 containers being used with one charge pump.

### Controlling the pressure

It is obvious that the amount of fluid passing through a given orifice in a given time will vary as the pressure. It is wasteful of fluid to use a pressure much above that required to produce a satisfactory spray pattern with the particular orifice. It is, therefore, desirable to keep the outlet pressure down to this level whatever the pressure in the container or air chamber may be.

A reliable reducing valve between the container and the nozzle is, therefore, very desirable. For convenience the 'Mysto' pressure-regulating valve

*Continued on page 240*

# Biological Control of the Giant African Snail in Hawaii

ALAN THISTLE

(*Division Director, Board of Commissioners of Agriculture and Forestry, Territory of Hawaii*)

*As the result of an insertion of an advertisement in a Japanese-language newspaper published in Hawaii in* 1935 *the giant African snail,* Achatina fulica *Bowdich reached pest proportions shortly afterwards. In this article Mr. Thistle outlines some of the biological methods undertaken to control and eradicate this pest from the Territory.*

'YOU too can be a rancher; you don't need acres of land; raise giant snails in your basement, backyard or even in a corner of your living-room. Giant snails produce delicious meat. Feed them on kitchen scraps or cull fruits and vegetables. Snail meat will cure consumption, heart disease, diabetes, stomach ulcers and many other common diseases. Send for your breeding pair today'.

In 1935 the above advertisement appeared in a Japanese-language newspaper published in Hawaii. Two or three residents of the Territory decided to become 'ranchers'.

## Pest proportions

Unfortunately, shipments of the giant African snail, *Achatina fulica* Bowdich arrived undetected by quarantine inspectors. Approximately one year later the presence of the snail was brought to the attention of the Board of Agriculture and Forestry. A programme of eradication was instituted immediately.

The original importers had reared a few thousand snails; they had sold a number of breeding pairs, given a few away and some had been eaten. None had cured any disease, common or otherwise. Nor had anyone found the meat delicious. Giant snails had escaped captivity in practically all areas where they were being raised.

The promulgation of regulations by the Territory making it illegal to have snails in one's possession frightened other snail growers and large numbers of the pest were thrown out. Only a few took the trouble to kill the snails first.

Various methods and chemicals were used in the attempt to eradicate the localised infestations. Eradication was obtained in a few instances. The Territorial Government expended approximately $800,000.00 from 1936 to 1951 for labour, chemicals and equipment in eradication and later in control programmes. By 1947 it became quite apparent that eradication was not possible by existing methods and chemicals. Control up to 98% was common, but the 2% remaining was sufficient to reinfest the area in a short time.

## Ecology of pest snail

In 1947 the snail was also present in most island groups of the Pacific where it had been taken by the Japanese for food and 'medicine' during the second world war. The U.S. Navy, which was administering the government of many of the infested Pacific islands at that time, employed Dr. F. X. Williams, an entomologist and resident of Hawaii. He was sent to East Africa, the native home of the pest snail. Dr. Williams's assignment was to study the ecology of the pest snail and to ship to Hawaii for study any natural enemies of the snail which would be otherwise harmless.

Dr. Williams found a number of predators, but no true parasites.

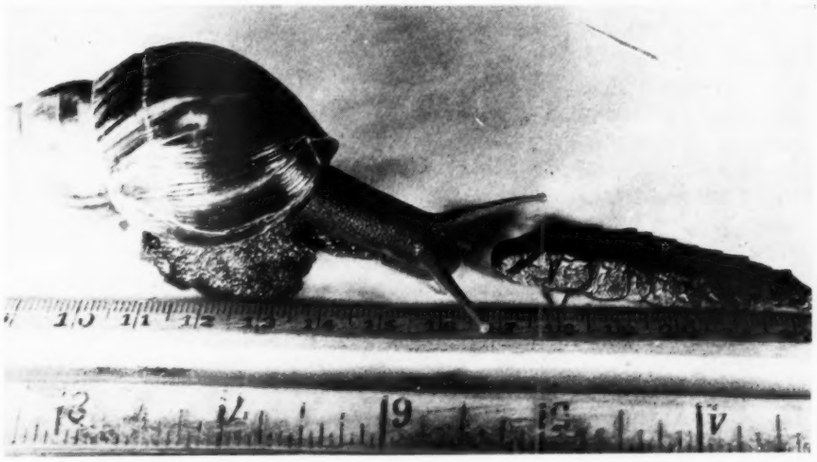
## Predators

*Gonaxis kibweziensis*, a carnivorous snail of the family stretaxidae, appeared to be the most important enemy of those considered for introduction.

*Tefflus* spp., a large black beetle of the carabidae family, was also considered of importance.

Colonies of both of these predators were shipped to Honolulu for study and testing. Other workers followed Dr. Williams and additional stocks of these predators were obtained in 1949–50 and 1951.

The authorities in Hawaii would not



Lamprophorus tenebrosus (right). *Large colonies of this giant African snail enemy have been obtained from Ceylon and released in Hawaii. The individual shown is a female larva. Larvae of both sexes feed on the pest snail*

Euglandina rosea (right), *a carnivorous snail introduced from Florida to assist in the control of the giant African snail* (left) *about ⅓ grown*

approve the field release of *Gonaxis* until it had proven its value as a control of the pest snail under field conditions. Consequently, in 1950, a colony of approximately 400 were taken to the uninhabited but snail-infested island of Agiguan in the Southern Marianas group. Yearly expeditions to Agiguan have definitely proven the worth of *Gonaxis* as well as indicating that it is strictly a snail feeder, including members of its own kind.

In 1954 it was estimated that the original colony of *Gonaxis* had multiplied to approximately 80,000. Sizable areas on the island were devoid of both the pest snail and the carnivore. Five hundred *Gonaxis* were collected and returned to Hawaii for field release. Three colonies are definitely established in snail-infested areas in Hawaii.

In 1955 it was decided to strip Agiguan of as many *Gonaxis* as possible because of the danger of their eradicating themselves. The 1955 expedition found additional areas where all ground snails had been eliminated. Over 8,000 *Gonaxis* were collected and distributed to all snail-infested districts in the Trust Territory of the Pacific Islands, as well as to Guam and the Hawaiian Islands.

A colony of *Tefflus* spp. was released on Oahu in 1951. One year later a specimen was recovered near the release area. There are other indications that *Tefflus* has established itself, because very few small or medium-sized *Achatina* can be found in this area.

Still another predator, the Indian glow-worm, *Lamprophorus tenebrosus*, a beetle of the lampyridae family, has been introduced from Ceylon. Over 5,000 individuals were released in 1954–55 on Oahu in the Hawaiian group. It is still too early to determine whether this snail enemy has established itself.

In 1955 the Board of Agriculture and Forestry's exploratory entomologist, Mr. Noel L. H. Krauss, was sent to Florida to search for colonies of another carnivorous snail, *Euglandina* spp., members of the family oleacina. The giant African snail is not reported from Florida or from anywhere in the Western Hemisphere, but it seemed worth-while to try it against *Achatina*.

Mr. Krauss was able to locate fairly large numbers of *Euglandina rosea* in citrus orchards near Leesburg, Florida. He found it feeding on the citrus-tree snail, *Drymaeus* sp., and a land snail, *Liguus* sp.

The individuals sent to Hawaii were found to attack *Achatina* readily. Since their diet is restricted to snails, Territorial authorities approved their release.

The four species of predators have been released in areas as far removed from each other as possible. *Tefflus* and *Lamprophorus* will undoubtedly attack both the carnivorous snails in addition to *Achatina*. It will be of particular interest, however, to see which of the carnivorous snails will dominate the other.

### Future plans

Future plans call for an expedition to the Congo region of Africa to study the enemies of *Achatina* species found there.

Through the introduction of additional predators and any parasite species which might be discovered, Hawaii hopes to reduce the population of *Achatina fulica* below pest proportions.

*Photos:* Philip Weber

## Nile Water Level

General J. K. Edwards, Assistant Minister for Agriculture, said in Nairobi that the Kenya Government would not know until the end of the year, at the earliest, how the water to be tapped from rivers flowing into Lake Victoria (source of the Nile), and used for irrigation in Kenya, would affect the level of the Nile.

Irrigation surveys are now under way and it is hoped that eventually 260,000 acres in Kenya will be irrigated from these rivers.

The Agricultural Minister, Mr. Blundell, when asked how the Aswan High Dam would affect the water supplies, said he would make no comment, as the matter was being dealt with by the British Government.

## Heda Oya Irrigation Project

The Ceylon Ministry of Lands and Land Development are considering postponing the Walawe Scheme and instead to proceed with a Rs.94 million multi-purpose irrigation project based on the Heda Oya and Karanda Oya in the south-east of Ceylon. It is understood that world-wide tenders will be invited when designs have been completed.

The project provides for the irrigation of 68,000 acres of paddy land, 22,000 acres of high land and the generation of about 1,000 h.p. of electrical energy; it envisages the construction of two reservoirs to absorb about 221 square miles out of an estimated catchment area of 540 square miles. Their storage capacity will be 280,000 acre-ft. and 85,000 acre-ft.

The Ministry would probably not set up a separate organisation to supervise this development work but would employ the Gal Oya Development Board whose duties at the Valley are scheduled for completion by 1960.

# Agricultural Progress in Canada—III

## Canada's Barley Crop

C. H. GOULDEN

(*Director, Experimental Farms Service, Canada Department of Agriculture*)

*Dr. Goulden continues his series of articles on Canadian agriculture by extensively surveying the place of barley in the agricultural structure. There is a brisk demand for Canadian malting barley and large quantities have been exported. Approximately 95% of Canada's barley is produced in the three prairie provinces of Alberta, Saskatchewan and Manitoba.*

BARLEY has always been an important crop in the agriculture of Canada, but during recent years it has become of even greater importance. The soils and climate of the Prairie Provinces—Manitoba, Saskatchewan and Alberta—are well suited for the production of high yields of good quality barley. There has been a spectacular rise in Canada's barley acreage and production during the past 10 years. World production, on a 1935–39 basis, placed Canada in sixth position as a barley producer. There was a rise to fifth place in 1949 and to first place in 1952 and 1953, *i.e.* among countries for which statistics are available. The Canadian crop in 1952 yielded approximately 291 million bushels whereas the 1953 crop yielded approximately 262 million bushels. The 1954 and 1955 crops were smaller and amounted to 175 million and 252 million bushels respectively, even though the 1955 acreage was at an all-time high. The prairie provinces usually produce over twice as many bushels of wheat as barley. Oats is second to wheat in terms of production but barley is second to wheat in terms of crop value.

### Malting varieties

Most of the barley produced in Canada, as is the case in the U.S.A., is 6-rowed barley. This is not the situation in Europe or in many other countries where 2-rowed barley is produced. Barley in Canada occupies an important place as a fattening and finishing feed for livestock. However, a considerable portion of the crop is used for the production of malt, malt products, pot and pearl barley, barley flour and meal. Approximately 10–15% of the crop is used in Canada for industrial purposes and another 10–15% may be exported in some years for the production of malt.

There has been a brisk demand, particularly during recent years for Canadian malting barley, and large quantities have been exported. Most of the malting barley produced in Canada comes from the west, and particularly Manitoba. In some years sizable quantities of malting barley are purchased in western Ontario and in parts of eastern Ontario and western Quebec. Nevertheless, the bulk of the barley produced in Eastern Canada is used as feed or seed.

Some 2-rowed barley is grown in Canada but mainly in the Atlantic Provinces and in some sections of southern Saskatchewan and Alberta and in central Saskatchewan. There is considerable interest in the performance of the newer European 2-rowed varieties and most of these are being tested. The influx of new settlers from Europe has helped to stimulate this interest in 2-rowed barley. However, in most areas the higher-yielding, 6-rowed varieties usually out-yield the 2-rowed varieties.

*Heads of Montcalm barley, the principal malting variety in Canada*

### Acreage and production

The acreage and production by provinces for the last 5 years are shown in Table I.

It may be noted that approximately 95% of Canada's barley is grown in the three prairie provinces. The ranking in order of production is Alberta, Saskatchewan and Manitoba. The amount of barley grown in pure stands in eastern Canada is small but a much greater acreage is grown in the form of mixed grain, usually barley and oats. For example, in Ontario there are 4–5 times as many acres of mixed grain as there are of barley. A freight assistance programme enables considerable quantities of barley to be shipped to Eastern Canada from the main producing areas for feeding, thus limiting the potential eastern acreage.

### Changing variety picture

Ten years ago the main variety grown in Canada was that famous old malting variety which was selected out of Manchurian barley O.A.C.21. The development of a new malting variety called Montcalm—the first malting variety actually bred in North America—meant that O.A.C.21 was to lose its predominant place quite rapidly. Montcalm was developed at Macdonald College in Quebec. It has led all varieties in acreage, both in western and eastern Canada for several years.

*Combining barley from the swath, Western Canada*

Recently, it has lost some of its popularity, owing, no doubt, to the fact that when a large acreage is seeded to a single variety, year after year, the diseases to which it is susceptible have a good chance to build up and become more serious each year. However, since Canada uses and exports considerable quantities of malting barley, there is a great demand for varieties with malting quality and there have not been many varieties among which to choose. Besides O.A.C.21 and Montcalm, there has been only one variety, namely Olli, an early maturing variety which is adapted mainly to central and northern Alberta. Therefore, Montcalm could only be replaced by a good malting variety.

Fortunately, a new malting variety has been developed at the Experimental Farm, Brandon, Manitoba. It was licensed for sale in Canada in 1956 and named Parkland. It is a smooth-awned, rust-resistant, strong-strawed, high-yielding, and widely adapted variety. It has performed well in all three Prairie Provinces. Seed will not be distributed to farmers until the fall of 1956.

There has been a marked advance in the development of 6-rowed feed varieties during recent years. No fewer than 13 varieties have been licensed for sale since 1945. One of the most outstanding is Vantage, produced at the Experimental Farm, Brandon, Manitoba. It has rust resistance, good straw, and good yielding ability. It is varieties like Vantage that have caused many farmers to become interested in growing barley. Another variety called Vantmore was released in 1955 as a replacement for Vantage in Manitoba. Another outstanding feed variety in Western Canada is Husky, released by the Field Husbandry Department at the University of Saskatchewan. This rust-resistant, strong-strawed variety has set new records for yields in many parts of the West.

## Special varieties

Canada is a large country and special varieties are needed for a great range of special conditions. Compana, a 2-rowed variety from the State of Idaho in the U.S.A., has become an important dry-land barley in southern Saskatchewan and southern Alberta. Velvon II, from the State of Utah, is grown to a limited extent in west central Saskatchewan. Harlan, a selection from Idaho named in Canada, has done well on irrigated land in southern Alberta, where its high yield and lodging resistance have been important. Wolfe is another variety developed for special conditions by the Experimental Farm at Lacombe, Alberta. It is for the park-land area of central Alberta where an early maturing variety is needed to escape early fall frosts. Another early variety named Gateway was developed by the University of Alberta at Edmonton. It will be grown in North Central Alberta and in the Peace River area. Fort barley is adapted to certain areas in eastern Ontario and its main feature is lodging resistance. A high-yielding, mildew-resistant variety named Brant was developed by the Ontario Agricultural College for Ontario conditions, especially where mildew infections are serious.

Winter barley is now being grown in some areas of western Ontario. It has insufficient winterhardiness for most areas of Canada and the only other regions where it can be grown successfully are in the coastal areas of British Columbia. Three varieties of winter barley have been licensed in Canada since 1945, namely Wong, Kenate and Hudson. Wong and Hudson came from Cornell University in New York State, and Kenate was selected at the Ontario Agricultural Collage. It is doubtful if winter barley will ever be grown to any great extent in Canada unless someone takes a definite step forward by creating a much hardier breeding stock. Research in the Experimental Farms Service is being conducted along this line by trying to incorporate the winterhardiness of some of the wild hordeum species into ordinary winter barley.

## Breeding new varieties

The plant breeders in the Experimental Farms Service and at the Universities are giving much attention to barley breeding and related research. The breeding programmes in the Experimental Farms Service are co-ordinated from coast to coast by the officer-in-charge of the barley unit, Cereal Crops Division, Central Experimental Farm, Ottawa. He is responsible for international co-ordination on behalf of Canada's barley-breeding efforts. He maintains a Canadian Genetic Stock Collection of barleys and exchanges breeding stock and seed of new varieties with institutions in many countries. A large plant-breeding programme is conducted at Ottawa for the breeding of new varieties and for the creation of new genetic stocks.

An extensive barley-breeding programme is maintained at the Experimental Farm, Brandon, Manitoba, and several new varieties have been produced. Barley breeding for both

TABLE I

ACREAGE AND PRODUCTION OF BARLEY IN CANADA BY PROVINCES 1951–55

| | 1951 | | 1952 | | 1953 | | 1954 | | 1955 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1,000 acres | 1,000 bushels | 1,000 acres | 1,000 bushels | 1,000 acres | 1,000 bushels | 1,000 acres | 1,000 bushels | 1,000 acres | 1,000 bushels |
| Prince Edward Island | 4 | 131 | 4 | 126 | 5 | 168 | 4 | 118 | 3 | 72 |
| Nova Scotia .. | 4 | 141 | 4 | 118 | 3 | 105 | 3 | 78 | 2 | 71 |
| New Brunswick .. | 14 | 476 | 10 | 268 | 9 | 338 | 9 | 255 | 7 | 127 |
| Quebec .. .. | 62 | 1,847 | 61 | 1,556 | 57 | 1,582 | 53 | 998 | 41 | 1,355 |
| Ontario .. .. | 194 | 7,333 | 203 | 6,699 | 171 | 6,156 | 144 | 4,723 | 144 | 4,752 |
| Manitoba .. .. | 2,040 | 56,000 | 2,165 | 71,000 | 2,365 | 61,000 | 2,202 | 44,000 | 2,090 | 40,000 |
| Saskatchewan .. | 2,449 | 73,000 | 2,644 | 92,000 | 2,745 | 82,000 | 2,313 | 53,000 | 3,846 | 104,000 |
| Alberta .. .. | 3,041 | 105,000 | 3,336 | 118,000 | 3,489 | 108,000 | 3,053 | 70,000 | 3,702 | 100,000 |
| British Columbia .. | 32 | 1,284 | 51 | 1,622 | 68 | 2,716 | 75 | 2,337 | 77 | 1,848 |
| Canada (total) .. | 7,840 | 245,212 | 8,478 | 291,389 | 8,911 | 262,065 | 7,856 | 175,509 | 9,912 | 252,225 |

dryland and irrigated conditions is centred at the Cereal Breeding Laboratory, Experimental Farm, Lethbridge, Alberta, and in co-operation with the dry-land Experimental Farms at Swift Current and Scott in Saskatchewan. Early barleys are being bred at Lacombe in central Alberta and at Beaverlodge in the Peace River area of northern Alberta. Breeding for resistance to leaf diseases is located at the Laboratory of Cereal Breeding, Winnipeg. The breeding of barley for Quebec province will be conducted at Ste. Anne de la Pocatière. Breeding of 2-rowed and 6-rowed barleys for the Atlantic Provinces and the breeding of joint-worm-resistant barleys is centred at the Experimental Farm, Charlottetown, P.E.I. Winter barley breeding is located at Ottawa, at the Ontario Agricultural College, and at the Experimental Farm, Agassiz, B.C.

The main breeding projects are directed towards the production of high-yielding, smut-resistant, lodging-resistant, smooth-awned varieties. Smooth awns are not too important in the west now that combines are in general use, and in fact rough-awned barleys lie better in the swath than the smooth, slippery ones. Marked improvements have been made during recent years in breeding barleys with stronger straw and better root anchorage, thus giving them more lodging resistance.

## Disease-resistant varieties

Breeding for disease resistance is as essential for barley as it is for wheat and oats and probably more so because the breeding of disease-resistant barleys has not received the same emphasis over the years as it has for the other cereal crops. Also, there are more barley diseases which can be of major importance in certain years.

There are many diseases which are serious drawbacks to successful barley production such as: mildew, *Erysiphe graminis;* stem rust, *Puccinia graminis;* net blotch, *Pyrenophora teres;* Septoria leaf blotch, *Septoria passerinii;* common root rot, *Helminthosporium sativum;* scald, *Rhynchosporium secalis;* leaf rust, *Puccinia hordei;* and the smuts. The smut problem is the most aggravating of all and the one which seems to bother growers more than any other, probably because the disease is so easily recognized and because it is so completely destructive to the heads concerned. The surface smuts, *Ustilago hordei* and *U. nigra*, do not present the same difficulties as loose smut, *U. nuda*. The difficulties encountered with artificial inoculation and the changing race picture of the loose-smut organism have made the task of breeding resistant varieties a long and slow one. However, a new mass-inoculation technique and a determination on the part of the plant breeders to put out smut-resistant varieties should mean that resistant varieties will be created before very long. Some of them are entering yield tests now.

It is expected that the barley crop will always remain one of Canada's most important cereal crops. Our climate and soils, particularly in the west, are well suited for its production. The disease problems are numerous but plant pathologists and plant breeders, by their combined efforts, should be able to keep production in a vigorous and healthy state. The industrial demands for barley, both at home and abroad, mean that it is important to have good malting varieties. In fact, the ideal barley for Canada is one which produces grain of good malting quality and, at the same time, is such a good yielder that it can be grown by those who only want feed barley—in other words, a dual-purpose variety.

*Field of Montcalm barley in the stook, Eastern Canada*

*Photo: p. 236, Canadian National Railways*

# Future Problems in Danish Agriculture

SIGURD PEDERSEN, M.SC.

*In this, the second of his regular reports from Denmark, the author discusses the economic conditions prevailing in Danish agriculture. He then outlines some of the problems that are likely to arise in the near future and suggests some possible ways in which many of the difficulties may be overcome.*

TODAY the economic conditions under which Danish agriculture is working can be characterised by the following: The prices for the products are solely determined by the developments on the world markets. From 1 October, 1956, the last long-term agreement with Great Britain—the one concerning bacon—will expire and then the effects of shifts in supply and demand will be the main determining factors for the income of the Danish farmers. Danish agricultural products are not subsidised by the Government at all. To this must be added the difficulties which meet our export products in the import countries in the shape of tariffs, quantitative restrictions and imported sales from other countries, which increase the price uncertainty in the future.

## Price determination

On the other hand, production prices are determined by factors outside the agricultural sector of the economy, especially by prices on imported raw materials, fuel and other goods. The domestic price level is quickly adapted to alterations in import prices through the automatic regulation of the wages after the cost-of-living adjustments. The relative stable prices for food on the world market in recent years in connection with increasing prices on imported goods mean that the terms of trade for Danish agriculture in relation to other industries have developed unfavourably.

On this basis the future problems for the industry arise. They can be summarised in the following questions: (1) How will it be possible for the farmers to increase productivity? Without influencing the price development the only possibility for the individual farmer is to increase production by using less production means. (2) How to organise the amount of the production and the sale of the commodities in order to get the highest possible price for the exports?

## How to increase productivity

The possibilities of increased productivity are determined by (*a*) the technical development and (*b*) the farmers' ability to utilise new knowledge. Consequently the development in productivity is closely connected with information and instruction on new methods and products, and with the economic possibilities of exploiting them, *e.g.* income should allow for some self-financing of investments and the borrowing possibilities should be such that the remaining investment demands can be fulfilled.

During the postwar years a considerable enlargement of the information service has taken place. The agricultural advisers who, in Denmark, are employed by the agricultural organisations have increased considerably in numbers and advisers in special fields, such as feeding, hygiene, machinery and buildings have been appointed. There are now about 1,000 advisers and assistants in Danish agriculture, or one adviser per approximately 200 farmers and per each 3,000 hours. Agricultural schools have been established and with a smaller number of young men entering the farming industry it means that a higher proportion of the coming farmers get theoretical education.

Today the number of pupils who take a half-year's course equal about half the number of young people starting as farmers.

## Experimental stations

The experimental stations for feeding and breeding have been increased. For example, new experimental stations for feeding pigs have been built and on large farms 32 progeny stations have been erected in order to examine the breeding value of bulls by controlling the yield of about 20 daughters.

In order to obtain a quicker spread of experimental results and practical experiences, an information office, which supplies the advisers with publications, films and other forms of agricultural news, has been established.

The economic importance of the above-mentioned arrangements as well as others is impossible to measure, but it is no doubt of great importance and a necessary link in a productivity-encouraging policy. This work must be continued and enlarged with the general development of the industry.

The other side of this question, namely, that in connection with financing the necessary investments must be considered on the basis of a large investment demand after the economically bad years of the '30s and difficult supply conditions in the '40s, which have meant that the investment requirements during the postwar years have been very large. From 1949 to 1954 relatively good incomes in Danish farming made it possible for the farmers to finance a large part of the considerable investments undertaken in that period by themselves. The smaller incomes in the last two years have raised the capital problem in Danish agriculture and if it is possible to go on with the mechanisation and betterment of the farm buildings more capital will be necessary.

A Government committee is working on these problems with the purpose of increasing the competition possibilities for Danish agriculture on existing capital. It is of the greatest importance for the economic growth of the industry that this problem can be solved. However, it must be remembered that the problem mentioned above, as well as that of production prices on the home market must be solved without intervention from the

State. The liberal attitude is still prevailing, although to a smaller extent than before.

### How to solve the export problem

In a competitive industry like agriculture the size of production will quickly adapt itself to alterations in price relations. In Danish agriculture this especially applies to bacon and egg production, which is quickly adaptable to alterations, especially in prices on imported feeding-stuffs. This means that a fall in world market grain prices soon will result in a larger production, and this again will result in declining prices. Danish agriculture is therefore interested in arrangements which enable the industry to avoid large fluctuations in the amount of production. This problem has been discussed but not solved. Among possible solutions a minimum import price for, or prohibition of purchase of, imported grain have been mentioned. A main problem in coming years may therefore be measures which enable a production development as steady and as natural as possible.

### Seasonal fluctuations

Another problem which arises in the free price formation is how to avoid the great seasonal fluctuations in prices paid to the farmers. This problem may be said to have been solved in respect of butter. The farmers' own co-operative organisation has established by a production levy a fund of about 100 million kroner (more than £5 million), which will be spent in equalising prices throughout the year. Something similar will be necessary for other commodities, because some knowledge of the future prices is of very great importance for the farmer in planning his future production.

A matter that is of the greatest importance is to spread the exports. To be able to sell as many different commodities on as many markets as possible is a main task for the future in order to reach the most stable price development. Since before the war some results in this direction have been achieved. The greatest hindrance for the attainment of this goal is the protective trade policy in most of the importing countries. To this must be added the importance of avoiding a competitive sale from a large number of Danish exporters. Danish farmers have therefore established their own export organisations, which deal with most of a considerable part of the total export. These organisations for single commodities will have to be coordinated in order to be able to obtain the best possible prices for the export commodities.

Today the Danish farmer is uncertain and worried about the future and feels that more than ever he is dependent on a good, honest yield. This is understandable, but it must not be forgotten that, although the future tasks are considerable, much can be done if only the economic policy meets the problems of the farmers and the difficulties from the importing countries do not increase in the coming years.

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# What is Agricultural Research?

The 1956 Annual General Meeting of the Society for Analytical Chemistry was held in London earlier this year and was followed by the Bernard Dyer Memorial Lecture, given by Sir William Slater, K.B.E., D.SC., F.R.I.C., Secretary of the Agricultural Research Council, entitled ' The Evolution of Agricultural Research '.

Sir William began by posing the question ' What is agricultural research?' Agriculture was not a science; it was an industry. Consequently a worker in agricultural research had to combine the qualifications of a scientist with an understanding of farmers and their problems.

Although before the first world war only the universities had provided a place for pure research, leaving consultant and applied practice as the main opening for scientists, the years between the wars had seen the growth of research institutes in which pure investigations were possible as well as the development of practical applications. This and the ease with which published original research could be used to support personal advancement has led to a growing tendency for universities to encourage graduates to look to pure rather than to applied research for a career.

### Applied research

Since the second world war the scarcity of men entering applied research has had added to it the problem of providing apparatus—spectrophotometers, calculating machines and even electronic computors—required for specialised research. There were many problems to be solved in providing that such equipment was fully used. In agriculture there was also the problem of providing facilities for work on farm animals.

Sir William illustrated his theme by describing the advancement by pure research of the solution to the practical problem of weed control. From the prewar practice of spraying onions with sulphuric acid, which ran off the narrow onion leaves but destroyed the flat leaves of the weeds with which it remained in contact, we had progressed to the use of the ' plant hormone ' type of weedkiller, the substituted phenoxyacetic acid products. Radioactive - tracer techniques were now permitting this work to be taken a step further. The number and variety of scientific experts needed for agricultural research was continually increasing.

### Intermediaries

Nevertheless, it was still necessary to have an intermediary who could explain to the farmer what the pure-research worker had discovered in the laboratory and to help in the application of the knowledge on the farm. The National Agricultural Advisory Service had in its specialist advisory officers men who could do this.

These men were invaluable in bridging the gap between pure and applied research, but there were all too few of them. Unless there was a body of similar men based on the research institutes, this liaison might break down.

### The future

Looking into the future, Sir William said, he saw two groups working together in the agricultural research institutes, one going ever deeper into specialised investigations in the laboratory and the other devoting itself to the immediate solution of the applied problems of the industry and maintaining contact with the Advisory Service and the farmers.

# Field Methods for Measurement of Pesticide Absorption

Two simple methods are now available, involving only simple and portable equipment, by which a medical officer or scientific worker can quickly determine the extent of absorption by agricultural workers of either organic phosphorus insecticides, or dinitrocresol-type weedkillers. The occupational hazards of these compounds fully justify periodic blood tests.

Both are visual comparator methods, the principle being the measurement of a colour change in a treated blood sample by comparison with a series of standard calibrated colour discs. The visual comparator and the two special 'choline-esterase' and 'DNC' discs are available from Tintometer Ltd., Colour Laboratories, Waterloo Road, Salisbury, Wilts, England, the price for a comparator and disc being about £6. The disc standards are permanent. Full detail of the exact method is available from the Tintometer Co. on request. The following are brief explanatory notes on the two methods.

### I.—Organic Phosphorus Insecticides

*Measurement of choline-esterase activity in whole blood samples*

A small drop of blood from ear, finger or thumb is pipetted into a dilute solution of a special indicator, *soluble bromothymol blue*. When all samples are thus prepared, a dilute solution of reacting agent *acetylcholine* is added to each tube. The choline-esterase reacts on the acetylcholine, causing the production of acid in the solution. This gradually changes the colour of the indicator from its starting shade of green-blue to its finishing colour of yellow-brown. With normal (100% choline-esterase content) blood samples the time taken for full colour change is 20–25 minutes.

If the blood choline-esterase is abnormally low, owing to absorption of organic phosphorus insecticides, the production of acid and colour change are proportionately reduced. Thus, such samples will show only a limited colour change in the same time as a control normal sample has fully changed. The test samples are matched with the appropriate one of a series of nine colour standards covering the range 0–100% choline-esterase activity, at intervals of 12.5% choline-esterase.

The indicator solution is stable for long periods, but the reacting agent, acetylcholine, has to be checked periodically for stability. The blood sample (0.01 ml.) can be taken from a single drop of blood. Precision of results is good (± one disc) and reproducibility high. The total equipment needed can be carried in a small case. Technique is simple, but must be carried out carefully and intelligently. Twenty unknown samples can be determined in about 1½ hours.

REFERENCE

Edson, E. F., *Brit. med. J.*, 14 May, 1955, p. 1218

### II.—Dinitrocresol or Dinitrobutylphenol Content in Whole Blood

A 1-ml. sample of blood taken from the arm vein by doctor, nurse or other trained person, is added to a test-tube containing 5 ml. of the solvent, methyl-ethyl ketone (MEK). A small amount of a solid $NaCl : Na_2CO_3$ mixture is added and the tube shaken vigorously. The solvent MEK extracts the yellow DNC or DNBP from the whole blood and is poured off to a further tube. The DNC or DNBP content is read off (in μg./ml. of blood) by matching the yellowness in the solvent to the nearest standard on the disc, which ranges from 0–45 μg./ml. at intervals of 5 μg./ml.

The measuring technique is extremely simple, the major disadvantage being that the blood sample requires procurement of an arm-vein blood sample. Analysis requires only a very few minutes. Precision is very satisfactory for all routine and emergency purposes.

This information was supplied by the Medical Department, Fisons Pest Control Ltd.

REFERENCE

Edson, E. F., *Lancet*, 8 May, 1954, p. 981

## Spraying Machines for the Small-scale Farmer

*Continued from page 232*

is incorporated with a strainer and stopcock in the lance handle. The stopcock is merely a device that relieves the diaphragm in the reducing valve from pressure, thus causing the valve to close. It is so simple that it can be operated by a finger or thumb of the hand holding the lance.

In pressure sprayers the throughput at the highest pressure may be more than double that at the optimum pressure. The saving in fluid effected by using a pressure-regulating valve is very considerable. This valve should be adjustable, without undue difficulty, to suit the particular nozzle being used.

### Supervision of manufacture

When manually operated machines were made individually by skilled craftsmen testing was incidental to production. If the machines are made by large-scale methods, the testing of each sub-assembly is very important and adequate arrangements for such supervision is essential. With containers subject to pressure, hydraulic tests to double the maximum working pressure should be applied before the components are fitted. It should be emphasised that the failure of some small component may put a sprayer out of action at a critical time. The consequences resulting from lack of supervision may be of life and death significance to some poor cultivator in a remote spot.

## Maize-Growing in Poland

Great importance is attached in Poland to the improvement in quality and quantity of maize-growing. In 1955 the area sown with maize was four times that devoted to the crop in 1954; by 1960, the final year of the five-year economic plan which started in January 1956, the area under maize will be in the region of a million ha. (2½ million acres).

Recent Government decisions lay down the measures by which this result will be attained. For the current year the target figure is 500,000 acres; the State farms will be responsible for nearly 190,000 acres of this cultivation —a third of their acreage will be for seed and silage and just under a quarter for green fodder.

# Solar Still Not Costly

Fresh water from brackish or salt bore water at the wave of a wand is something that has long been the dream of graziers and pastoralists in the sunburnt areas.

Distilling bore water into fresh water is nothing new. Nor has it been cheap. All methods of distillation previously used have needed expensive fuels and the coal, wood, oil and electricity are not always available.

The answer to the problem may be a small timber and glass structure on view at the Beaurepaire Tyre Service, Mildura, Victoria, Australia. Here, on 18 January, 1956, the world's first commercial solar still began operating, reports *The Australian Producer* in a recent issue.

The still consists of a glass sheet roof, forming a sealed, tent-like compartment over a shallow tray of waterproof black plastic material. Brackish water is siphoned into the tray and evaporated by the sun. The resulting vapour condenses on the inside of the panes of glass and runs into small gutters on either side of the tray and is collected.

The keynote of the solar still is simplicity and unfailing reliability. The small unit at Mildura could easily be made by any handyman or ' bush ' carpenter, using inexpensive material.

### No maintenance

Once it begins operating, no fuel, maintenance or upkeep is needed. The only attention required is to clean dust from the glass panes and to occasionally remove the residue left in the tray.

Bore water delivered into the still is controlled by a floating-ball valve.

A solar still built to this design will produce 30 gal. of water a year to each square foot of tray space. In Mildura this is five times the amount of rain that falls on a square foot of land in one year.

The Mildura solar still is about 44 sq. ft. and can deliver on average 5–6 gal. a day. It is not necessary to have the direct rays of the sun to operate the still; it will operate in daylight, even on cloudy or wet days. However, bright sunlight would get best results.

The solar still reaches maximum efficiency when it is most needed—that is, during hot, dry weather. During cloudy or rainy periods the output slackens and, proportionately, so does the demand.

### Harnessing the sun

The solar still at Mildura was built at the Footscray factory of the Olympic Tyre and Rubber Co. Pty. Ltd. as a contribution to Australian research into solar energy devices. It incorporates suggestions made by the Division of Industrial Chemistry of the C.S.I.R.O. Mr. B. W. Wilson, principal Technical Officer of that division, is advising the company.

Solar distillation of bore water has passed the ' gadget ' stage and presents a practical solution to Australia's inland water problem.

Sheep grazing may readily benefit. One thousand sheep could each be provided with a gallon of drinking water a day by the construction of a solar still measuring 50 ft. × 100 ft.

This unit would produce 500 gal. of distilled water a day, which, mixed with an equal quantity of salt bore water, would provide 1,000 gal. of suitable drinking water.

The cost of building such a solar still would be a little less than 10s. a square foot. This does not include labour costs, as construction is so simple that the property owner or existing labour strength could erect it.

Apart from the normal risk of broken glass, no further expense is incurred.

' When one considers the immense cost of keeping fresh water by drilling, or the cost of water cartage, it is obvious that the solar still will be of immense benefit to property owners ', say the makers.

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### To Authors and Readers

The publishers of WORLD CROPS invite the submission of manuscripts of books to be considered for publication. All manuscripts will be promptly acknowledged and carefully considered by qualified experts. A synopsis with chapter headings should be sent in the first instance, addressed to the Book Production Manager.

The publishers are specialists in industrial, technical and scientific books and have a world-wide selling and distributing organisation.

### Cocoa Plantation in Southern Cameroons

Negotiations have recently been concluded between Cadbury's and the Southern Cameroons Government for the lease by Cadbury's of 1,200 acres at Ikilliwindi, some 15 miles north of Kumba, which is the centre of the territory's developing cocoa industry.

### Site clearance

The firm has already begun the clearing of the site, which it proposes to develop into a model cocoa plantation, as they wish to encourage cocoa production in this area.

### Other new firms

The lease of this land to Cadbury's is fully in accordance with the Southern Cameroons Government's intention to attract overseas plantation and other enterprise to the territory, and the Government hopes that the successful conclusion of the negotiations with Cadbury's will encourage other firms to come to the territory.

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### A New Journal

A new journal—FLOORS—has started publication in association with the long-established BUILDING MATERIALS, Components and Equipment, one of the Leonard Hill Technical Group.

In recent years there have been many new developments in both the construction and covering of industrial, domestic and other types of floor, and it has long been felt by architects and the building trade generally that there should be a publication devoted to giving details of these developments.

It is with this object that the new journal has been published. Incorporating the enquiry card system that has been a feature of BUILDING MATERIALS, it will include articles on the various new methods of construction, new protective and decorative treatments, and reviews of new floor finishes as they are introduced. There will also be general articles dealing with the requirements of floors which have to serve a specific purpose in various kinds of industrial and commercial buildings, and a section devoted to the latest developments in other parts of the world.

FLOORS is initially appearing as an inset to BUILDING MATERIALS, but will soon be published independently.

*Dr. R. C. Brian (Head of the Physical Chemistry Section) explaining to the Duke of Edinburgh the Langmuir Trough method of studying the resistance of plants and weeds to hormone weedkillers. Sir Alexander Fleck is on the left*

# Duke of Edinburgh at Jealott's Hill

His Royal Highness the Duke of Edinburgh visited the Jealott's Hill Research Station of Imperial Chemical Industries Ltd. on 10 April. His Royal Highness arrived by helicopter and was greeted by Sir Alexander Fleck, K.B.E., F.R.S. (Chairman, I.C.I. Ltd.), and other members of the Main Board.

## Aims

Jealott's Hill Research Station, which is part of Central Agricultural Control, I.C.I. Ltd., is the main centre of I.C.I. agricultural research. The reason for its existence is that agriculture, at home and overseas, makes a great and growing demand on the chemical industry to help solve many of its problems.

Jealott's Hill acts as a link between agriculture and the chemical industry —to define the needs of agriculture and to help in finding ways to meet these needs. The work is by no means restricted to the testing of chemical products; it embraces fundamental long-term research as well as applied research.

## Hormone-type weedkillers

His Royal Highness visited many of the sections, including the Soils and Fertilisers Laboratory, which is interested primarily in the effect of soil factors on crop yields; the Field Experiments Section; the Intelligence Section; the Botany Laboratory, in which one of the principal lines of research is the study of growth mechanisms in plants. A spectacular result of their work was the discovery there, during the war, of the hormone weedkillers. He also visited the Physical Chemistry Laboratory, where studies are being made of the factors which contribute to the resistance of plants and weeds to weedkillers.

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## *Nyasaland Rice Project*

Because of a considerable drop in the world price of rice, a Nyasaland rice-growing project on which £20,000 has been spent in the past two and a half years is to be closed down, it was officially announced in Blantyre on 3 April. The scheme concerned is at Sombani, near Lake Chilwa, in the south of Nyasaland.

## *World Citrus Production*

World citrus fruit production in 1955–56 may set another record high.

The International Federation of Agricultural Producers reports the current crop of oranges and tangerines in the Northern Hemisphere is estimated at around 297 million boxes, about 6% above last year's record crop.

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## *Israeli Exhibition of Agriculture*

The First Secretary (Commercial) British Embassy, Tel Aviv, has reported that an Exhibition of Citriculture, Citrus By-Products, Agricultural Machinery and Israel Agricultural Exports will be held simultaneously with the Fourth International Congress of Mediterranean Citrus Growers at Tel Aviv from 20 May to 16 June, 1956.

### Aims

The aims of the exhibition are to demonstrate the progress achieved in citriculture in Israel, in the Mediterranean Zone and in other citrus-producing countries.

The exhibition will be held on a site of approximately 16 acres on the outskirts of Tel Aviv and will be arranged by sections, covering irrigation, cultivation, chemicals, sorting and packing. A special section will be devoted to the progress made in the production of citrus concentrates, juices and other products.

### Implements

On view at the exhibition will be the various methods, implements and machines currently in use for irrigation, pruning, manuring, spraying etc., in addition to the various systems and equipment and for washing, packing and shipment of the fruit. The exhibition will open to the general public.

The First Secretary (Commercial) is of the opinion that the citrus growers and exporters in Israel could use more British machinery and handling equipment and that the exhibition could well be the opportunity for U.K. exporters of such material to display those manufactures and goods which have not hitherto been sold in Israel or which have only sold in small quantity.

# NEW PUBLICATIONS

## Agricultural Ecology

By Girolomo Azzi. Pp. xv + 424, illustrated. London: Constable and Co. Ltd. 1956. 45s.

Professor Azzi's book is claimed to be the first textbook on the science of agricultural ecology, which is defined as the study of physical characteristics of environment, climate and soil in relation to the qualitative, quantitative and reproductive development of plants. This English edition of a book originally published in Italian is welcome because it gives additional publicity to a science of inestimable value in devising experiments embracing a number of countries on crop problems which hitherto have been conducted on national rather than international lines.

The author develops the concept that yield is not an absolute value, but the result of relationship between productivity and resistance to surrounding adversities. To determine the effect of any one growth factor it must therefore be made to vary to its extreme limits, all other factors remaining constant. This can only be achieved by differential analysis of yields, whereby it becomes possible to isolate the action of each factor.

The first part of the book is devoted to agricultural climatology, where climate is represented by the frequencies of favourable and unfavourable situations through excess and deficiency of temperature and rainfall, while the growing plant goes through definite vegetative sub-periods, the water requirement varying from one sub-period to another. Subsequent parts deal with the soil unit and climate–soil complex, ecological characteristics correlated with the different degrees of productivity and resistance and, finally, factorial combinations and differential analysis of yield, in which the author shows how by integrating widespread geographical trials with differential analysis of yields it is possible to determine the influence on yield of any single factor or group of factors and to determine the mean yield under varying varietal and cultural conditions. There is emphasis of the powerful action of environment which permits the survival only of those forms which respond to the requirements of an equilibrium between being and environment.

The main value of Professor Azzi's most interesting book is his ability to marshal facts which carry conviction because they are logical and clearly expressed and because he defines with precision and gives direction to a new science which offers a firm basis for organised research on problems concerned with the adaptation of crops to environment.

D. H. GRIST

## Yellow Podzolic Soil on Granodiorite

The genesis of a maximal yellow podzolic soil with solodic features has been studied by means of mineral analysis and thin sections. The results of apparent density and porosity measurements, and calculations based on the percentage of zircon in each soil horizon and in the rock, show that there is a progressive increase in the degree of weathering of all the primary minerals from the deepest horizons to the surface. The conclusion is drawn that weathering and removal of the products of weathering of both primary minerals and secondary clay minerals are the dominant processes in the genesis of this soil; either clay illuviation, if active at all, is a minor contributing factor or else the illuviated clay has been removed by subsequent severe mineral decomposition. A sequence of processes is suggested for the genesis of the soil. This is Soil Publication No. 5 published by the Commonwealth Scientific and Industrial Research Organisation, Australia, 1955.

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## Observations of Sugar Cane Diseases in Australia and Fiji, 1955

The information contained in this report was obtained during a visit to the sugar-producing areas of Australia and Fiji in the early part of 1955. The principal object of this tour was the study of sugar-cane diseases and their control, with particular reference to ratoon stunting and Fiji diseases. Valuable information was obtained on experimental work undertaken by the various research organisations in the field of sugar-cane agronomy in general. Prepared by Robert Antoine, A.R.C.S., B.SC.(LOND.), DIP.AGR.SC.(CANTAB.), for the Mauritius Sugar Industry Research Institute.

*

## Determination of Knock-Rating of Motor Fuel

This British Standard is technically identical with the Institute of Petroleum's specification IP 44/55 [technically equivalent to specification D.357-53 of the American Society for Testing Materials (A.S.T.M.)] and specifies the motor method (also known as the CRC-F2 method) of determining the knock characteristics of fuels for use in spark-ignition engines in terms of an arbitrary scale of octane number (O.N.) under relatively severe conditions. This is British Standards publication B.S.2637-38 : 1956.

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## Economic Aspects of the Rice Industry, 1955

This is a report of the Third Special Meeting on the Economic Aspects of the Rice Industry, which was held in Bangkok, Thailand, on 30 September to 7 October, 1955. The meeting started by surveying the world situation and outlook for rice and found that the main immediate problems continued to be those arising from the accumulation of rice surpluses in several rice-producing countries. The meeting noted further that consumption appeared to be expanding and welcomed the steps that were being taken in a number of countries to facilitate the further expansion of consumption. The main attention of the meeting was devoted to the problem of reducing fluctuations in international trade in rice.

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## Agriculture in the World Economy, 1955

The purpose of this booklet is to demonstrate the importance of agriculture in the world's economy. The role played by agriculture has often been under-estimated and this tendency to underrate the essential function performed by the world's farmers, fishermen and forest workers has sometimes led to a niggardly treatment of the world's largest primary industry.

This publication tries to give in as non-technical language as possible and with the help of simple graphs a rough outline of agriculture's development, resource use, production trends and proportion of the world's income, all seen against the background of a rapidly growing population and clearly inadequate living standards in large parts of the world. Price $1.00 or 5*s.* 0*d.*

*

### Commodity Reports: Rice: No. 6: 1955

This Commodity Report is the sixth in the series of periodical reports on rice prepared by the Rice Section, Commodities Branch, Economics Division. It is based on information and statistics available to the end of December, 1955. Price $0.25 or 1*s.* 3*d.*

*

### West African Institute for Oil Palm Research, 1954-55

We have just received a copy of the Third Annual Report. After a report from the Administration Sections a great deal of interesting information and experimental results have been supplied by the various research divisions, *i.e.* Agronomy, Plant Breeding, Plant Pathology, Plant Physiology and Plant Production. Price 2*s.* 6*d.*

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### Other Publications

We have received copies of the following publications:

*Annual Report for* 1955 *of the East African Agriculture and Forestry Research Organisation.* Price 3/50.

*Proceedings of the Third Conference of the Tea Research Institute of East Africa,* Pamphlet No. 12.

*Annual Report for* 1954 *of the Tea Research Institute of East Africa.*

*The Control of Pests and Diseases of Farm and Market Garden Crops,* 1956. Published by the Murphy Chemical Co. Ltd., Wheathampstead, St. Albans, Herts.

*Census of Agriculture,* 1952, *Part* 1—*Tea Plantations.* Department of Census and Statistics, Ceylon, 1956.

*Plant Protection Guide to Pests and Diseases of Fruit.* London: Plant Protection Ltd.

*Guide to the Manuring of Ceylon Tea* 1955. Pamphlet No. 1 Tea Research Institute of Ceylon.

# CORRESPONDENCE

TO THE EDITOR

DEAR SIR,

I feel that a journal of the repute and international circulation of WORLD CROPS should be, if not guarded, at least accurate in its editorial comment. Your note on ' Soil Analysis ' in the December 1955 issue has, in endeavouring to point out some of the possible limitations of soil testing, merely demonstrated your own ignorance of modern research in this sphere, or that of the author you quote. It is true that soil analysis in Britain has not attained the same standard or the same degree of precision as in other parts of the world, nor in a way has it been as necessary, because of the vast wealth of experience of the behaviour of the different soils. But such a situation certainly justifies no sweeping generalisation. I am not so concerned with your strictures on the accuracy of field sampling, although they are false, as with your truly extraordinary statement: ' The chemical means by which " available " plant foods are extracted, leaving behind the " non-available " supplies, are based entirely upon assumptions '. Modern methods of soil testing use chemical procedures which may in a sense be arbitrary, but they are calibrated in terms of plot tests and field responses, from which regression coefficients are obtained. In other words, soil analysis extracts the vital information from experimental evidence and interprets it for varying soil conditions.

The great mass of painstaking and accurate work which is being done everywhere in the world on soil analysis as an aid to better farming is ill served by such thoughtless comment as yours.

Yours faithfully,

B. S. ELLIS, PH.D., D.I.C., F.R.I.C.,
*Chief Chemist.*
Federal Ministry of Agriculture,
Salisbury,
Southern Rhodesia.
9 *April,* 1956.

*We must, perhaps, accept some of the criticisms made by Dr. Ellis—we should have made it clearer in our comments on soil analysis that the limitations we emphasised are much more seriously encountered in older agricultural countries, especially in Western Europe. Climatic factors, too, may have their influence. Certainly the calibration controls he rightly refers to are much more effective, much more capable of reducing margin of error, in a country where many farm soils are relatively virgin and where a small-field cropping pattern has not added to frequency of local variations in soil nature. We feel doubtful if the encouraging developments he is able to report could be similarly developed in, say, the U.K. or Holland, for there would surely be many more influences to vary the relationship between chemical test data and crop yield data.*

*We did say that our comments would seem to be ' fairly strong meat '. With the wider use of sampling and analysis in postwar farming we felt that, at any rate for Western Europe, some warning about the limitations of soil analysis would not be unconstructive, for some farmers adopt an almost slavish attitude to the results. An example of the complex problems to be faced in interpreting analysis data in Britain has been commented upon (in this issue)—the surprising swing in available phosphate status of soils sampled by the East of Scotland College of Agriculture. Could any system of calibration explain so marked a change occurring in 12 months? —Ed.*

### Damascus International Trade Fair

A representative of the Federation of British Industries has signed an agreement in Damascus for the participation of the U.K. in the annual trade fair which is scheduled to open on 1 September. The agreement is also valid for 1957 and 1958, reports the Agricultural Engineers' Association Ltd.

An area of 40,000 sq. m. has been allocated to the British Pavilion, half of which will be reserved for heavy machinery and transport exhibits. The U.S.A., U.S.S.R., France and Communist China will also take part.

### Yarmouk Dam Plans Dropped

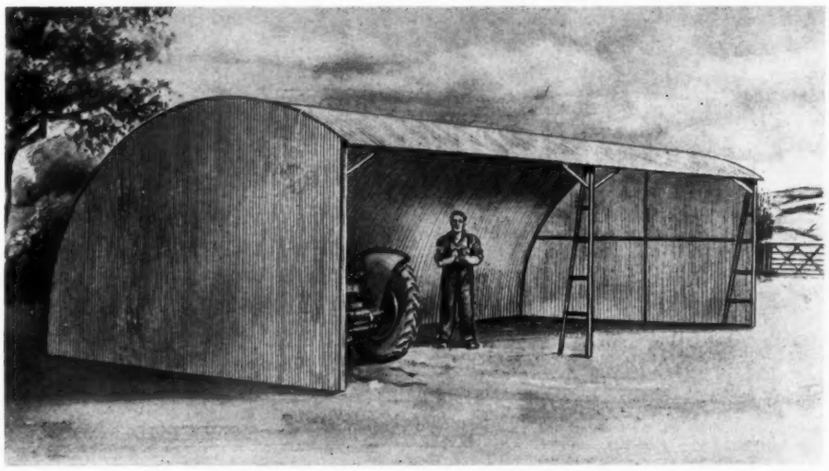
The Agricultural Engineers' Association Ltd. report that the Jordan Government has dropped its joint plan with Syria to build a $40 million dam on the Yarmouk River and dissolved the Syrio-Jordanian Yarmouk Committee.

The dam would have stored 500 million cu. m. of water and permitted irrigation of 70% of the area planned to be covered by the American ' Johnson Scheme ' (which provides for joint Arab-Israeli exploitation of the River Jordan, as well as the Yarmouk River).

# MACHINERY AND EQUIPMENT

### *Implement Shed*

An implement shed has been designed by C. G. Smith of Bristol Ltd., 343 Wells Road, Bristol 4, England, to supply the demand for sturdy coverage at a relatively low price. It is constructed by skilled labour in easily handled parts. The standard bays of 15 ft. each give lengths of 30 ft., 45 ft. or 60 ft. with a width of 15 ft. at ground line, and the curved sheeting provides a height of 7 ft. 3 in. clear at the front. The main covering is provided by curved 22-gauge, galvanised, corrugated sheets. The simple steel framework consists of a front line of braced angle purlins supported on lattice posts of angle-steel members. At each end a curved rail at the top and one intermediate rail and post are introduced to support the end covering of 24-gauge corrugated steel sheeting, which is cut to shape at the works.



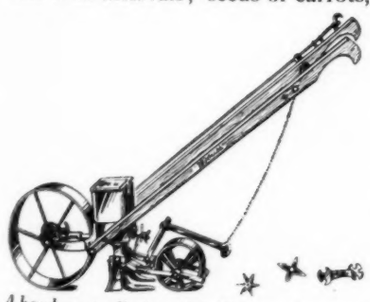
*All nuts, bolts, hook bolts and sheeting clips are supplied with ' Smistol ' Universal Implement Sheds. Posts should have concrete foundations and corrugated sheets at ground line should be let in concrete*

### *Blade-type Plough Shares*

The Star Manufacturing Company (Division of Illinois Iron and Bolt Co., Carpentersville, Illinois, U.S.A.) have announced that they are now manufacturing a new line, Star blade-type plough shares. They are made from solid steel of a special cross-section and special analysis—rolled especially to their own strict specifications—then heat treated automatically to provide maximum strength and wearing qualities. They are fitted with special nuts and bolts, applied (' staked in ') in a manner comparable with that used by the original manufacturers.

### *Seed Drill*

Among the many horticultural implements manufactured by Mousset Frères, 77 Boulevard Voltaire, Paris (11e), is a hand-operated seed drill. It is made for seeding in continuous drills or in intervals; seeds of carrots, onions, maize, radishes etc. can be sown with this implement. It has a metallic hopper with the distributor regulated by the rate of travel of the front wheel. The shares are adjustable for working depth, and the rear part of the shares turn the soil over the seed. The soil is then tamped down with a rear roller. The diameter of the wheel is 420 mm. and the total weight is 20 kg.



*A hand-controlled seed drill manufactured by Mousset Frères, France*

### *Compressed-air Sugar-beet Harvesting*

It was reported in *Deutsche Landwirtschafliche Presse*, No. 17, p. 252, that, although agricultural machinery has been developed to a high degree of technical efficiency, it is rarely used in harvesting such vegetables as potatoes or beets, as mobile machines are not suitable for such work and do not produce large yields.

Potatoes and beets are therefore still predominantly harvested by manual labour. In view of the fact that, especially in dry years, the heavy beet soil is almost as hard as asphalt, this work is extremely difficult. Inspired by modern methods of road construction, compressed-air machinery has recently been adopted for the harvesting of beets. Shovels and cutters are replaced by forks, which the compressed air pushes into the soil to a carefully regulated depth which eliminates all risk of damaging the beets. Apart from relieving the worker of the heavy task of pushing the fork with his own muscles into the ground, compressed-air tools are thus superior to hand hoeing in this respect also. Moreover, the output per hour per man amounts to eight times that of hand harvesting.

The compressed air is produced by a mobile compressor driven by a normal tractor and is conducted to the compressed-air instruments by long hoses. As the work proceeds, tractor and compressor move on across the harvested field. The beet leafage is also removable by compressed-air instruments.

This information was provided by *E.P.A. Technical Digest*, No. 425.

### *Idling Control*

An idling control that reduces the engine to idling speed with a flick of a lever is a feature of the new Winco 2,500-W. direct-drive engine-generator just announced by W. L. Lockhart, Generator Sales Manager of the Wincharger Corporation, of Sioux City, Iowa, U.S.A.

The purpose of the exclusive new Wincharger idling development, called the ' Conserv-er ', is to conserve fuel, extend engine life and lower maintenance cost. The new plant is known as the Series 205B14S2D, and has just been released for production in April by the well-known electrical-equipment manufacturer.

*The 'Steel Squirrel', designed to speed up orchard operations that are now carried out from the ladder*

Additional optional features include the lightweight, a king-sized generator designed to give unusually close, steady voltage regulation, and an indicator pilot light. Also available as optional equipment are the Winco two-wheeled ' Speedy-Shift ' dolly and a retractable starter.

The 205B14S2D-1M2 is powered by the famous Briggs and Stratton No. 14 engine.

The Wincharger Corporation, which is a wholly-owned subsidiary of Zenith Radio Corporation, also is known as a leading manufacturer of dynamotors for aircraft and other military equipment and universal motors for appliances and power tools.

Included in the Winco engine-generator line is a complete range of sizes from 500 W. up, many of them either single-phase or three-phase with all standard voltages.

### Vineyard Plough

The G & M Equipment Co., P.O. Box 267, Winton, California, U.S.A. are able to supply the G & M vineyard plough, designed for easy working in vineyards. Its principle of automatic knockout prevents injury to vines, roots and stakes. The implement is easily adapted to toolbar, single bottom and disk, or it can be operated independently. It is adjustable in depth, beam and shear and it may also be operated in tandem with a single plough. The manufacturers claim that it turns easily and experiences no side draft.

*The 'Worth' Standard Sheep and Pig Trailer Model C.T. of 12-cwt. capacity*

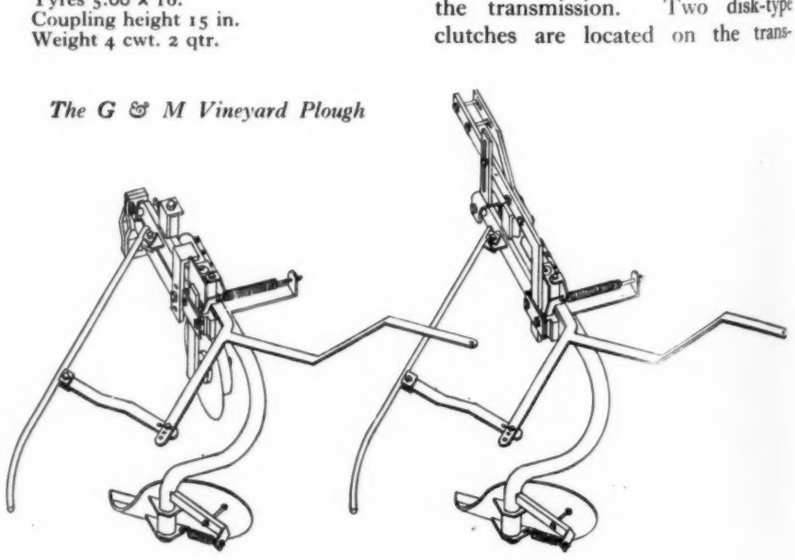
### Sheep Trailer

Jerry Wadsworth & Son Ltd., Oldham Road, Ripponden, nr. Halifax, Yorks, manufacture a large range of stock trailers. The 10 C.T. Model sheep and pig trailer is among those offered. To allow for long life and easy handling it is of all-steel, welded construction. The tow bar is twin-steel sectioned and designed to give strength without undue weight. It is fitted with the patent ' Worth ' quick-release ball coupling and automatic and hand-ratchet brake.

Specifications

Length inside body 6 ft.
Width inside body 3 ft. 2 in.
Height of sides 3 ft.
Overall length 8 ft. 8 in.
Overall height 4 ft. 4 in.
Wheel track 4 ft. 3 in.
Tyres 5.00 x 16.
Coupling height 15 in.
Weight 4 cwt. 2 qtr.

*The G & M Vineyard Plough*



### Steel Squirrel

The ' steel Squirrel ' is a machine designed to speed up ladder operations of pruning, thinning and picking in the production of deciduous fruit and to reduce overall costs of operation. The machine is manufactured by Blackwelder Manufacturing Co., Rio Vista, California, U.S.A.

#### Design details

The main frame of the ' Squirrel ' is triangular in shape. A standard automotive rear-axle assembly forms the base of the triangle. The apex of the triangle carries a free-castering third wheel. Power applied to the pinion drives the axle assembly in the conventional manner, and steering is accomplished by braking either drive wheel to pivot sharply through 360° on a turning radius of 74 in. for the 10-ft. model.

A 6½-h.p. standard air-cooled gasoline engine propels the unit and also supplies power to the air compressor.

A V-belt drive from a second sheave on the compressor supplies power to the transmission. Two disk-type clutches are located on the trans-

mission input shaft. Movement of the central shifting collar rearward engages one clutch and supplies power to a gear drive to turn the output shaft in one direction. Movement of the shifting collar forward disengages the gear-drive clutch and engages the chain-drive clutch to turn the output shaft at the same speed as the gear drive, but, of course, in the opposite direction. When the shifting collar is centred, both clutches are disengaged and the transmission is in neutral. A chain drive connects the transmission output shaft to the sprocket on the differential pinion.

A telescoping channel-type tower assembly and the pneumatic-lift cylinder are rigidly mounted at the centre of the frame. The pneumatic cylinder, as it extends, raises the inner tower. A cable passing over a sheave mounted at the upper end of the inner tower lifts the roller-mounted workers' platform, called the ' crow's nest ', at twice the speed at which the cylinder extends.

**Controls**

All controls are mounted on the crow's nest to enable the operator to manoeuvre the whole machine at any time regardless of his height above the ground. The air and brake hoses are routed over sheaves in the same manner as the lift cable. One end of each is attached to the crow's nest and rises and descends with it. A hand- or foot-operated air valve allows the operator to raise or lower himself by foot control while continuing to use both hands to work in the tree. An air outlet in the crow's nest provides for attachment of standard pneumatic tools.

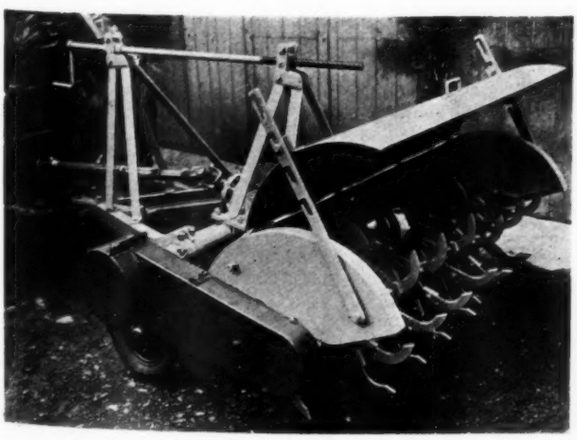
A pair of conventional automotive master brake cylinders under the crow's nest floor supply pressure to brake cylinders in the main drive wheels.

By use of a square rod and sliding square tube arrangement and suitable linkage, a hand lever in the crow's nest controls the action of the clutches in the transmission below. Both clutches are disengaged with the lever in the vertical position. Movement of the lever engages the proper clutch to move the machine in the direction of lever movement. Control is positive, regardless of elevation of the crow's nest, so that it is not necessary for the operator to descend to move the machine around through the orchard.

**Adaptable**

The machine is widely adaptable. It has worked successfully in the sub-tropical avocado and orange groves of southern California and in the other types of orchards throughout the year, with work ranging to pruning in the snow-covered orchards of the Pacific North-West.

*The SWR side-delivery rake is one of the several Lanz agricultural implements to be more widely distributed in Britain*



*The new Fishleigh Trailer-model Rotary Cultivator. Two land wheels are mounted in front of the tine shaft to eliminate all wheel marks*

### Rotary Cultivator

The main features of the Fishleigh trailer-model rotary cultivator (The Fishleigh Rotary Cultivator Co. Ltd., Vicarage Lawn, Barnstaple, North Devon) are that its weight has been reduced from 22 cwt. to 12½ cwt.; the width of cultivation is now 5 ft. in place of 4-ft. machines; and 6-ft. machines can be supplied to order. The two land wheels are now mounted in front of the tine shaft, thereby eliminating all wheel marks.

The drive from the p.t.-o. of the tractor to the reduction gear box of the cultivator is by means of a Hardy Spicer universal coupling shaft. From the main drive shaft to the tine shaft roller chains, mounted at each end of the shaft, are employed. Attached to each drive is a Ferodo-lined safety clutch. The depth control is governed by a square-thread screw, operated from the tractor seat.

### Lanz Implement Supplies

H. Leverton & Co. Ltd., of Spalding, Lincs, announce that supplies of Lanz agricultural equipment are to be increased in Britain, starting immediately with the widespread distribution of the Lanz side-delivery rake. Supplies of the latest Lanz self-propelled combine harvester and oil-bath tractor binder will also be increased.

The side-delivery rake will operate in every position up to 40°. Its central

*The manually propelled Model A.C. Agricultural Truck, manufactured by Charles Pitt (Barton Stacey) Ltd. It has a glass-fibre container*

driving gear is located immediately above the cylinder turning point and gear changing is not affected by the cylinder working angle. The cylinder is driven by silent V-belt.

Apart from its simplicity of design and wide range of adjustment for varying conditions, the Lanz side-delivery rake has a practical layout of double tines. This system allows easy and instant replacement of unserviceable tines and greatly assists routine maintenance. Uneven ground is accommodated by floating suspension, a method which permits lengthwise and sidewise movement, in addition to allowing vertical movement of the spring-mounted chassis and cylinder.

The machine is easily hitched to the tractor p.t.-o. and power drive shaft and all working parts are pressure lubricated at readily accessible points.

**Specification—SWR 80 rake**

Length, 115 in.; width, 110 in.; height, for transport, 65 in.; maximum working width for turning, 8 ft.; maximum working width for raking, 6 ft. 6 in.; maximum offset position of drum, 40°; service weight, 850 lb.

### *Versatile Truck*

Among the range of trailers made by Charles Pitt (Barton Stacey) Ltd., Barton Stacey, Hants, is the Model A.C., an agricultural truck with glass-fibre tipping containers. It is manually propelled and mounted on 16 × 4 wheels at the rear and 14 × 3 at the front with two heavy-duty ball-bearing castors. The large-diameter, wide-based tyres on this model make it suitable for agricultural purposes or any other use where the going is rough. The height to the top of the container is 3 ft. 10 in.

All containers are made of glass reinforced-polyester base resin; they are suitably strengthened with steel inserts. They are considerably lighter and more durable than any other similar container and may be used to carry a large variety of liquid, semi-solid and solid loads. The cubic capacity is 0.84 cu. yd. (140 gal. approx.).

### *Grain Conveyor*

Percy Hendy Ltd., Vincent's Walk, Pound Tree Road, Southampton, Hants, recently introduced a horizontal grain conveyor after an experimental trial period of two years.

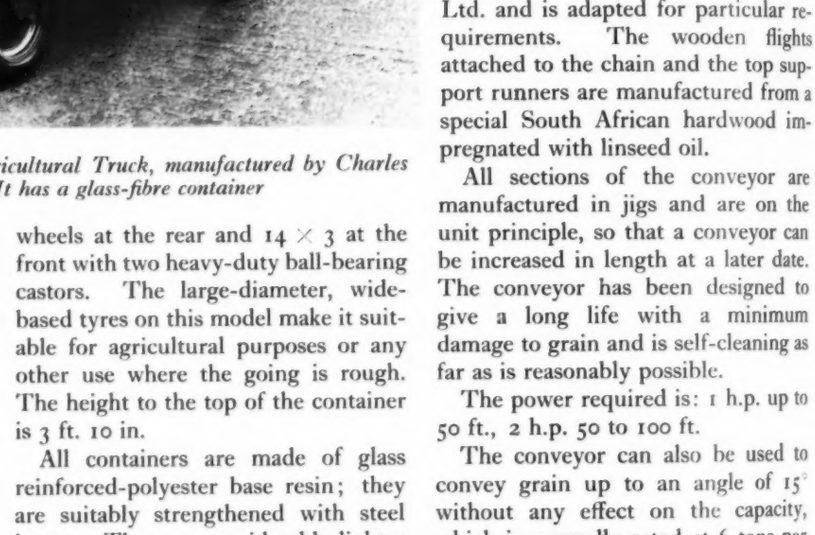
**Specification**

The conveyor troughing is made in 8-ft., 6-ft., 4-ft. and 2-ft. sections from 16-gauge galvanised sheeting. The conveyor chain is made by Renold's Ltd. and is adapted for particular requirements. The wooden flights attached to the chain and the top support runners are manufactured from a special South African hardwood impregnated with linseed oil.

All sections of the conveyor are manufactured in jigs and are on the unit principle, so that a conveyor can be increased in length at a later date. The conveyor has been designed to give a long life with a minimum damage to grain and is self-cleaning as far as is reasonably possible.

The power required is: 1 h.p. up to 50 ft., 2 h.p. 50 to 100 ft.

The conveyor can also be used to convey grain up to an angle of 15° without any effect on the capacity, which is normally rated at 6 tons per hour with a clean sample of wheat.



*A Hendy Horizontal Conveyor, 26 ft. long, feeding drier from auger elevator outlet*

# WORLD CROP REPORTS

### RHODESIA

**Tobacco**

Although the official tobacco crop estimate has not yet been announced, everything points to a bigger and possibly better yield and price than last year's record. This was the general opinion expressed by various people in the marketing and grading business in Salisbury on 28 February. An official of the Rhodesia Tobacco Association said that, although no violent fluctuation in the price of tobacco was expected there was every likelihood of beating the previous record for Southern Rhodesia. Last year 120 million lb. of tobacco realised the record sum of £20,326,476. The total area under tobacco last year was 173,000 acres. There are roughly 3,000 growers in Southern Rhodesia.

### JAMAICA

**Sugar**

The latest estimate of the 1956 sugar crop, made as at 31 March, was 372,000 tons, an increase of 2,000 tons on the previous estimate. Production closed last season at the record figure of 396,551 tons.

### ISRAEL

**Sugar**

The area devoted to sugar-beet in Israel is being extended year by year. In 1955 from 5,600 dunams (1,232 acres) sown to the crop about 22,400 tons of roots were produced. This season more than 6,900 dunams have been sown and a total yield of beet in the region of 37,000 tons is anticipated, according to Barclays Bank D.C.O.

*Czarnikow Rev.*

### BRAZIL

**Rice**

Brazil produced 3.9 million tons of rice in 1955, according to figures issued by the Brazilian Institute of Statistics. This was the largest crop ever produced in Brazil and was about 2% of the world total production, the Institute added.

The main centre of production was Sao Paulo with 1,100,000 tons, followed by Rio Grande do Sul with 859,000 tons, and Minas Gerais with 682,000 tons.

During the past two years Brazil's rice production has been consumed locally and no exports have been registered. In 1947–48 exports totalled 210,000 tons, but by 1953, the last year in which exports were recorded, they had dropped to 2,000 tons.

### ARGENTINA

Widespread rain and the absence of excessive heat favoured growing *maize* and *sunflower-seed* crops during January. Grazing lands were in good condition, except in south-western Buenos Aires, where swarms of grasshoppers reached plague proportions. British insecticides to combat this scourge were imported by air.

The harvesting of fine grains is almost finished. First official estimates of forage crops are:

| | | |
|---|---|---|
| Oats | .. | 808,000 tons |
| Barley | .. | 993,000 ,, |
| Rye | .. | 724,000 ,, |

All are about 10% below last year's yields.

The 1955–56 *wheat* crop is now estimated at 4,820,000 tons. A crop of maize of 4½ million tons is expected.

Official estimates for the fruit crops are:

| | | |
|---|---|---|
| Apples | .. | 285,000 tons |
| Peaches | .. | 145,800 ,, |
| Pears | .. | 102,000 ,, |
| Plums | .. | 48,000 ,, |
| Quinces | .. | 16,700 ,, |
| Apricots | .. | 9,500 ,, |
| Cherries | .. | 2,270 ,, |

*Spec. Reg. Inform. Serv.*

### MEXICO

A severe spell of cold weather in the middle of January has caused much damage to agriculture and may eventually have an effect on this year's harvests. Preliminary figures for 1955 crops show all-time records for many products. Wheat production amounted to 900,000 tons, which compares with 671,000 tons in 1953; maize totalled 4,700,000 tons, against 4 million in 1953; beans reached 590,000 tons, whereas only 523,000 tons were harvested in 1953, and rice came to 227,000 tons in 1955, compared with 152,000 tons in 1953.

During 1956 there will be approximately 23 million acres of land under cultivation. Of this total, approximately 6 million acres will be watered from irrigation schemes.

*Coffee.*—This season's coffee crop is estimated at 1,200,000 sacks, of which about 300,000 sacks will be needed for domestic consumption.

*Rubber.*—The authorities are endeavouring to encourage the production of natural rubber as part of their agricultural programme. Some rubber is already produced in the tropical areas of the country, but it is believed that production could be stepped up steeply at little cost. There is a large local tyre industry in the country and the aim of the rubber-growing programme is to produce locally sufficient crude rubber for the industry's needs.

### ENGLAND AND WALES

**Agricultural report**

Agricultural conditions in England and Wales on 1 April, 1956, have been summarised by the Ministry of Agriculture, Fisheries and Food.

Good progress was made with cultivations and sowing and work is well forward. Germination was slow, owing to cold, dry weather. Autumn-sown wheat has made good recovery from the February weather, but a good deal of the relatively small areas of autumn-sown barley and oats will have to be resown.

**Weather conditions**

The weather during March was generally dry and mostly sunny, but with cold winds and night frosts, especially in eastern areas. There were fairly widespread thunderstorms in the second half of the month, but rainfall generally was below average.

**Autumn-sown crops**

*Wheat* has made good recovery in most districts from the damage sustained in February and on the whole crops look well. A little patching or redrilling has been necessary in some areas.

*Barley* was severely damaged by frost—particularly the spring varieties sown in the autumn—and many fields will have to be resown. True winter varieties have recovered well in many districts.

*Oats* suffered damage from the February weather and many crops will have to be resown. In some districts

crops are recovering, although cold winds and frosty nights early in March have checked progress.

*Rye* has stood the winter well on the whole and is satisfactory.

*Beans.*—Reports on autumn-sown beans show some variation. In some districts frost damage was severe and resowing and patching will be necessary, but in other areas crops have made good recovery.

**Spring cultivations and sowing**

Conditions were very favourable for cultivations during the month and good progress was made. Land worked well and work is well forward.

Very good progress was made with spring sowing, but germination has been slow, owing to cold and dry weather.

**Potato planting and sugar-beet**

Good progress was made with the preparation of land for potato planting and work is well forward. In some districts most of the early varieties have been planted and in a few areas the planting of second early and main-crop varieties has begun.

The preparation of land for sugar-beet was also well forward and drilling has begun in some districts.

**Condition and growth of pastures**

*Leys* sown last autumn are rather patchy in some districts, owing to dry conditions at the time of sowing, and some areas will have to be resown; some frost damage is reported. Spring-sown leys have been slow to make growth, but were improving towards the end of the month. Damage by pigeons is reported from several areas. Other leys are generally backward.

*Permanent pastures* were beginning to freshen in some districts, but generally have made little or no growth.

## *URUGUAY*

Frequent and well-distributed rains were experienced throughout the country early this year and pastures were offering ample feed for the time of year. The condition of livestock is satisfactory and supplies are improving.

Climatic conditions have favoured the late sowings of sunflower seed and maize and above average harvests are anticipated. The preparation of land for winter sowings was well advanced, favoured by the soft state of the ground for the time of year.

*Spec. Reg. Inform. Serv.*

## *INTERNATIONAL*

**Wheat**

The latest circular of the leading *French* grain firm, J. A. Goldschmidt et Cie, puts this year's wheat crop at 6 million to 6,800,000 metric tons, compared with 10½ million tons in 1955.

There was now official confirmation of the complete destruction of an area of 2 million ha. under wheat and the partial destruction of 1½ million ha. through the earlier frosts, it is said. Recent weather conditions had not been favourable because of a drought.

Estimates based on reports furnished by field officers of the *New Zealand* Department of Agriculture indicate that the wheat harvest for the 1955–56 season will be the lowest recorded for years.

Total production, estimated at 2.9 million bushels, is approximately 1¼ million bushels less than for the previous season, reflecting a substantial decline in the area planted this season.

*Canadian* farmers plan to reduce wheat plantings this year by more than 600,000 acres in the fourth annual consecutive decline, the Bureau of Statistics reports. The Bureau's figures, based on a 1 March survey, showed that wheat plantings would be brought down from 21,505,800 acres to 20,848,100, the lowest level in 13 years.

This season's wheat harvest in *New South Wales* will amount to about 57 million bushels, according to the State Agriculture Department's cereal specialist, Mr. Walkden-Brown. This would compare with about 40 million bushels last season, when bad weather had caused a low yield.

**Maize**

The U.S. Agriculture Department has estimated world maize production in 1955–56 at 6,195 million bushels, compared with 1954–55 output of 5,575 million bushels.

The 1955 output was a new high, exceeding the previous record of about 6,000 million bushels produced in 1948, the Department said. The bulk of the increase in 1955 over 1954—620 million bushels—was in the Soviet Union and the U.S.A., but a large part of the Soviet acreage was harvested immature and used for silage and fodder.

The Department's estimates were little changed from its previous forecasts, made in February, when 1955 output was placed at 6,190 million bushels and 1954 production at 5,540 million bushels.

The report noted that the maize harvest was in progress in the Southern Hemisphere. 'In Africa', it said, 'the current estimate of 320 million bushels is 30 million bushels less than the large 1954 crop, but is sharply above average. The above average crop is principally due to expansion of the area in maize in many countries, especially in the *Union of South Africa*. In that country the current acreage of 8½ million acres contrasts with about 7 millions in 1935–39 and 7,100,000 in 1945–49. Acreage is also larger in *Egypt*, the second largest producer of the continent. The harvest in the Union of South Africa is now under way and tentative forecasts place the out-turn at about 105 million bushels. This is somewhat smaller than early prospects had indicated'.

Of *South American* prospects, the Department stated: 'Latest information points to a crop of about 530 million bushels. This would be at the 1953 level and 18% above the small crop last year. It is still, however, somewhat below the prewar level, largely because of the sharp reduction in *Argentina*. That sizable reduction is only partially offset by increases in *Brazil* and *Colombia*. 'The current crop in Argentina is tentatively forecast at 175 million bushels, compared with 100 million bushels last year and the 1935–39 average of 302 million bushels. The crop in Brazil, now the largest producer of the area, is indicated to be at the high level of the past two years'.

**Estimates preliminary**

The Department's report listed 1954 and 1955 production and said the estimates that had been revised for the Northern Hemisphere countries and Southern Hemisphere forecasts were preliminary.